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JOURNAL OF THE EAST AFRICA NATURAL HISTORY SOCIETY AND CORYNDON MUSEUM

VOL. XXIV No. 2 (106)

January 1963

CONTENTS

	<i>Page</i>
Cyperaceae of East Africa By D. M. Napper	1
The Milkweed Butterflies of East Africa By R. H. Carcasson	19
Breeding of the Black-headed Herons at Nairobi, Kenya, 1958-62 By M. E. W. North	33
Grey Kestrels in Tanganyika By E. Loosemore	67
Nature Note	65
Bird Notes	71
Letter to the Editor	78

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EAST AFRICA NATURAL HISTORY SOCIETY AND CORYNDON MUSEUM

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CYPERACEAE OF EAST AFRICA - I

By

D. M. NAPPER

Introduction

The sedges are regarded by many people as being 'worse than the grasses' to recognise and identify. Since, owing to their economic value, the latter group has been covered by various official publications for Kenya, Uganda and, shortly, for Tanganyika, it seems appropriate that the other major family in the Glumiflorae should now receive attention.

It is hoped that this and the series of papers which follow it will stimulate the collection of these interesting and too rarely gathered plants, as in many cases little or nothing is known of their habitat, distribution and variation. The species recorded here, and the names given to them, are merely the result of routine work carried out in the East African Herbarium and do not necessarily make a complete list of all material collected.

Owing to the diversity of vegetative form and inflorescence found throughout the larger genera, botanists find it extremely difficult to separate them and have relied on minute characters of flower structure and seed, examination of which requires the aid of a microscope; an attempt has been made here to separate both the genera and species occurring in a limited area on the more readily observed characters of root, leaf and inflorescence. All characters used in the keys will be found to be visible on careful examination with a x 10 hand lens, though occasionally a needle or pin may be necessary to separate the spikelets or remove a nutlet. Explanations of the botanical terms employed can be found in the Glossary of the Flora of East Tropical Africa.

The Cyperaceae is predominantly a family of moist habitats, damp meadows, river banks, swamps, etc., and has a world-wide distribution. Although relatively poor in number of genera the family includes two very large ones, Cyperus and Carex; the former is mainly tropical in its distribution and occurs throughout East Africa, while the latter occurs chiefly in the temperate areas of the northern hemisphere and its few tropical representatives are restricted to the cooler montane regions, in East Africa rarely at altitudes lower than 7,000 ft. Twenty-five genera occur in East Africa and with the exception of Cyperus they are all fairly small, with from 1 to 30 recorded species.

Characters of Taxonomic Importance.

Vegetative. It cannot be too strongly emphasised that to simplify the naming of sedges, especially the many species of Cyperus, the underground parts need to be dug out and examined. To find out whether the plant is annual, has stolons, or has a creeping rhizome

with long or very short internodes and tubers is usually easier than dissecting the spikelets under a microscope. Whether the sheathing bases of the lower leaves are swollen into a pseudo-bulb or not can be an equally important feature.

It is rarely wise to place too much reliance on the recorded size of the plant except where this is noted in relation to habitat, as most sedges are very sensitive to available ground water and show considerable variation in size accordingly.

Inflorescence. Solitary spikes, dense heads, simple and compound panicles are all to be found in the family, and frequently in the same genus, so they rarely make useful characters for generic distinctions; but for separating related species, the form of the inflorescence and the shape of the bracts at its base, their number and length relative to the inflorescence are characters of value. The colour of the spikelets is also helpful, but since this often varies from green when young to golden brown on maturity, care must be taken to ensure that mature specimens are examined.

The spikelets, being the ultimate divisions of the inflorescence, need a more detailed examination. The number of glumes, whether all are nutlet-bearing, whether fertile ovary and stamens are in the same flower (best ascertained by the presence of nutlet and persistent filaments) are among the characters used in the keys, as well as glume length, nutlet size and shape, etc. The finer points have been avoided as far as possible in order to keep the keys simple.

Flower and Spikelet Structure. Spike and spikelet are much more varied in the sedges than in the grasses and care must be taken in the use of these terms as, for example, a short female spike of a Carex may look very like an unmodified spikelet of a less specialised sedge. The basic spikelet pattern is that of a raceme (as in Cyperus, Scirpus etc.) or a cyme (as in Rhynchospora, Scleria etc.) of 1 to many bisexual florets, each with a subtending bract (Fig. 1), these spikelets then being variously arranged in spikes, umbels, capitulae, etc. (Figs. 7 - 12). Floral reduction of some sort occurs in all species; the corolla is reduced to small hypogynous bristles or scales or, more frequently, is completely absent (Figs. 2 - 5); the stamens are variously 2 or 3, mostly the latter, and may be present in the fertile flowers or only in unisexual ones. It is quite usual in spikelets with several florets for some of them to be bisexual and some staminate, either above or below the bisexual. Completely barren flowers are often present at the base or apex of such a spikelet (Fig. 1). The ovary contains a single ovule and has a single style with 2 or 3 branches; in the former instance the mature nutlet is lens-shaped, in the latter it is triangular in section. In some genera the number of style branches seems to be linked with the other generic characters, but in others both forms occur.

Reductions also occur in the number of flowers in a spikelet and in some genera authors have attached primary importance to the number of nutlets matured per spikelet. Where the number of flowers is reduced, there is often a correlation with separation into unisexual spikelets (subfamilies Sclerieae and Cariceae etc.). In the Cariceae a further peculiar modification of the spikelet

occurs. The bract or glume of the fertile flower is expanded and the margins fused to form the 'utricle' which completely surrounds both the flower and its rhachilla, so the so-called glume is really the bract subtending the spikelet. In Schoenoxiphium where the spikelet consists of a single basal fertile flower and several staminate ones above it the rhachilla and staminate flowers protrude from the mouth of the utricle (Fig. 6) and the nature of the "glume" is more obvious. In Carex the reduction is more extreme and the fertile spikelet is represented only by the bract and the utricle containing the nutlet (Fig. 3). Utricles enclosing the nutlets are also found in Coleochloa, but in this genus the spikelets are hermaphrodite and the utricle develops within the perianth of the female floret which is represented by conspicuous long hairs (Fig. 2).

The Tribes of the Cyperaceae according to their Natural Affinities
(Based on Hutchinson - Fam. Fl. Pl. Ed. I, Vol. II, (1934))

Flowers unisexual

Utricle present Cariceae

Utricle absent Sclerieae

Flowers hermaphrodite

Hypogynous scales well developed, folded, often enclosing the flower Hypolytreae

Hypogynous scales absent, filiform, or broader and flat

Glumes spirally arranged, spikelets not compressed

Spikelets with several empty glumes at the base and only 1 - 2 flowers..... Rhynchosporae

Spikelets with 2 - 0 empty glumes and more numerous flowers Scirpeae

Glumes distichous, spikelets often compressed..... Cypereae

Cariceae

- Carex, Schoenoxiphium

Sclerieae

- Scleria, Diplachrum, Acriulus, Coleochloa

Hypolytreae

- Hypolytrum, Ascolepis

Rhynchosporae

- Cladium, Carpha, Rhynchospora, Remirea

Scirpeae

- Ficinia, Bulbostylis, Fimbristylis, Scirpus, Eleocharis, Fuirena, Lipocarpha

Cypereae

- Kyllinga, Pycnus, Mariscus, Courtoisia, Juncellus, Cyperus.

Key to Genera

1. Utricles present, completely enclosing the nutlets 2
Utricles absent 4
2. Utricles surrounded by long hairs..... Coleochloa
Utricles not surrounded by long hairs..... 3
3. Stiffly erect perennials of montane forest or alpine grassland; utricles containing a solitary female flower Carex

Cyperaceae of East Africa

- Slender forest perennials with scanty
inflorescences; some or all of the utricles
with the staminate portion of the spikelet
or its rhachilla protruding, rarely all
reduced to the female floret only..... Schoenoxiphium
4. Large leafy perennials 3 - 8 ft. high 5
Small plants 3 ins. - 3 ft. high, or if
larger, then with leafless stems though
a few basal leaves may sometimes be present11
5. Glumes grey-green with a conspicuous reflexed
terminal bristle (rarely straight) Fuirena
Glumes brown or green, sometimes purplish..... 6
6. Nutlets globose, large and whitish,
partially exposed Scleria
Nutlets small, 2- or 3-angled 7
7. Leaf margins coarsely serrate or toothed..... 8
Leaf margins entire10
8. Peduncles short, up to 3 ins. long 9
Peduncles slender 3 - 8 ins. long Acriulus
9. Nutlets 3-angled Cladium
Nutlets 2-angled Hypolytrum
10. Spikelets compressed; glumes distichous
(2-ranked); style branches 3 Cyperus
Spikelets plump; glumes spirally arranged;
style branches 2 Rhynchospora
11. Inflorescence a solitary spikelet; subtending
bracts small and scale-like12
Inflorescence variously compound with at
least 2 spikelets16
12. Succulent-stemmed leafless plants Eleocharis
Slender leafy plants13
13. Spikelets small, up to 4 mm. long14
Spikelets over 8 mm. long15
14. Subtending bracts 1 or more, as long as
or longer than the spikelets Scirpus
Subtending bracts, if present, about as
long as the glumesEleocharis
15. Spikelets whitish or cream Fimbristylis
Spikelets brown Bulbostylis
16. Glumes distichous; spikelets compressed (Cyperus s.l)36
Glumes spirally arranged; spikelets not compressed17
17. Inflorescence white or yellow, daisy-like,
the hypogynous scales large with
petal-like extensions Ascolepis

- Inflorescence various but never with daisy-like "petals", hypogynous scales small or absent18
18. Spikelets whitish; inflorescence capitate or subumbellate (see Remirea).....19
Spikelets variously coloured but never white20
19. Leaves basal only Lipocarpa
Numerous stem leaves also present Rhynchospora
20. Spikelets dense, plump, with grey-green glumes (rarely brown) having a conspicuous and usually reflexed terminal bristle Fuirena
Spikelets dense or lax, but the glumes not as above (except Fimbristylis squarrosus which has whitish glumes with green bristles).....21
21. Inflorescence paniculate with usually leafy bracts, or contracted into an unbranched, interrupted spike22
Inflorescence capitate or umbellate, bracts rarely leafy26
22. Nutlets globose, white or bluish, partly exposed in the spikelet23
Nutlets not visible, 2- or 3-angled24
23. Annuals or perennials over 9 ins. high Scleria
Small annuals 2 - 7 ins. high Diplachrum
24. Style branches 2; nutlet 2-angled Rhynchospora
Style branches 3; nutlet 3-angled or rounded 25
25. Peduncles short, up to 1½ ins. long Carpha
Peduncles 3 - 8 ins. long Acriulus
26. Rhizomatous perennial of the seashore; very rare Remirea
Not as above27
27. Inflorescence capitate28
Inflorescence umbellate33
28. Flowering head appearing lateral, the subtending bract looking like a continuation of the stem Scirpus
Flowering head terminal29
29. Heads composed of 1 - 3 spikes30
Heads of numerous spikes31
30. Head over ¾ in. wide Rhynchospora
Head up to ½ in. wide Kyllinga
31. Perennials with stout woody rhizomes Ficinia
Annuals or perennials, slender rhizomes sometimes present32

Cyperaceae of East Africa

-
- | | | |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 32. | Heads usually very dark, brown or purplish <u>Bulbostylis</u>
Heads pale green <u>Scirpus</u> | |
| 33. | Leaves filiform or narrow; heads with small
scaly bracts 34
Leaves wider, flat; heads with foliose
subtending bracts 35 | |
| 34. | Spikelets very small, not over 1.5 mm. wide..... <u>Bulbostylis</u>
Spikelets larger, at least 2 mm. wide <u>Fimbristylis</u> | |
| 35. | Heads globose <u>Scirpus</u>
Heads spike-like <u>Mariscus</u> | |
| 36. | Style branches 2; nutlet 2-angled37
Style branches 3; nutlet 3-angled38 | |
| 37. | Inflorescence appearing lateral, the subtending
bract looking like a continuation of the stem... <u>Juncellus</u>
Inflorescence obviously terminal, with
several unequal bracts <u>Pycneus</u> | |
| 38. | Glumes with a conspicuous wing on the keel <u>Courtoisia</u>
Glumes rounded on the back, or keeled but
not winged39 | |
| 39. | Glumes deciduous, falling from the persistent
rhachilla <u>Cyperus</u>
Glumes not deciduous, the rhachilla and
glumes falling together <u>Mariscus</u> | |

CAREX L.

Carex is one of the larger genera of sedges, with nearly 1,000 species most of which occur in the temperate regions of the northern hemisphere. In tropical Africa there are only about 30, restricted to the damp grasslands, forest and montane vegetation of the higher altitudes (mostly over 7,000 ft.). The similar, but more slender, representatives of Schoenoxiphium in East Africa normally occur at lower altitudes.

Most African species of Carex are leafy perennial herbs, some with creeping rhizomes and some compacted into dense tufts. Three kinds of inflorescence are readily recognisable in the genus; solitary, dense bisexual spikes (Fig. 13); much branched, often dense panicles with numerous short sessile or subsessile bisexual spikes of few spikelets (Figs. 18, 25); and very sparingly branched inflorescences of a few sessile or pedunculate long spikes (Figs. 20, 38). The spikelets are always unisexual. In some species they are borne in unisexual spikes, in others the spikes are bisexual. In the section Eu-Carex three obvious trends occur in the arrangement of male and female in the spikes. In C. vallis-rosetto and its allies all the spikes are bisexual with the male spikelets at the top. In the rest, the upper 1 to 3 spikes are male or almost entirely so with the lateral spikes predominantly

female; in some of these species the male spikelets are above the female in the spikes, in others the male spikelets are below. In the field, male spikelets may be recognised either by the presence of stamens or, when these have been shed, by the absence of utricles as the male flowers mature first and shed their stamens before the utricles reach maturity.

Key to Species

1. Spikes solitary, terminal 2
 Spikes several or numerous 3
2. Culms angular; glumes light brown with broad
 hyaline margins 1. C. monostachya
 Culms terete; glumes dark brown, margins
 not hyaline 2. C. runssoroensis
3. Spikes sessile, bisexual; inflorescence
 always very dense 4
 Spikes pedunculate, unisexual or bisexual;
 inflorescence paniculate 6
4. Leaves 2 - 4 mm. wide; utricles much longer
 than the bracts and with a long scabrid
 beak 5. C. erythrorrhiza var. scabrida
 Leaves 4 - 12 mm. wide; utricles scarcely
 longer than the bracts, beak often
 very short 5
5. Utricles 3 - 4 mm. long; leaves 4 - 8 mm.
 wide; culm bases up to 6 mm. thick
 3. C. conferta var. leptosaccus
 Utricles 4 - 6 mm. long; leaves 8 - 12 mm.
 wide; culm bases over 7 mm. thick 4. C. lycurus
6. Inflorescence much branched with very
 numerous, scarcely stalked, short spikes 7
 Inflorescence of a few long very dense
 spikes, usually with long peduncles 10
7. Utricles much longer than the mucronate
 chestnut bracts 8
 Utricles equalling or scarcely exceeding
 the aristate bracts 9
8. Utricles pale green, hispid below the
 beak, 4 mm. long 6. C. spicato-paniculata
 Utricles very dark brown or black,
 glabrous, 5 mm. or more long 9. C. castanostachya
9. Utricles 4 mm. long 7. C. echinochloe
 Utricles 5 - 6 mm. long 8. C. chlorosaccus
10. Lateral spikes always distinctly pedunculate;
 leaf sheaths parallel veined 11
 Lateral spikes sessile or subsessile;
 leaf sheaths reticulate veined 24

Cyperaceae of East Africa

11. Utricles with a very short truncate beak 12
 Utricles with a well developed beak,
 bidentate except in C. johnstonii 13
12. Utricles brown, biconvex and very broad;
 bracts green 10. C. papillosissima
 Utricles 3-angled, narrower; bracts
 tawny 11. C. bequaertii
13. Female spikes loose; utricles 5 - 7 mm.
 long with a long entire beak 12. C. johnstonii
 Female spikes dense; utricles 3 - 5 mm.
 long with a bidentate beak 14
14. Spikes all androgynous, similar; male
 spikelets making less than half the
 length of the spike 15
 Upper 1 - 3 spikes usually male or almost
 entirely so, the lateral spikes female
 or bisexual 17
15. Utricle bracts golden brown 15. C. mildbraediana
 Utricle bracts green or brown 16
16. Utricle beak conspicuously bent 13. C. vallis-rosetto
 Utricle straight 14. C. greenwayii
17. Lateral spikes female, the upper ones usually
 with several male spikelets at the top;
 terminal spike often with a few female
 spikelets at the base 18
 Lateral spikelets purely female, or some
 of the upper ones with a few male
 spikelets at the base; terminal spike
 often with a few female spikelets at
 or near the top 20
18. Spikes 2 - 3 ins. long, brown or green 16. C. cyrtosaccus
 Spikes 1 - 2 ins. long, reddish or green 19
19. Bracts 5 - 6 mm. long, as long as the
 mature utricles 17. C. elgonensis
 Bracts 4 mm. long, shorter than the
 mature utricles 18. C. mannii
20. Lateral spikes all unisexual, 5 mm. wide 21
 Lateral spikes mostly bisexual, 6 - 8 mm. wide 22
21. Bracts black, with a conspicuous green
 midrib 19. C. simensis
 Bracts green and rust 20. C. fischeri
22. Leaves stiff, longest spikes 2 ins. long;
 lower glumes rust coloured, shorter than
 the utricle; peduncles stoutish, usually
 short 21. C. cuprea
 Leaves flaccid; spikes often over 2 ins. long;
 glumes brown, as long as the utricles;
 peduncles very slender and long 23

23. Leaves 3 - 4 mm. wide; mountains west of the Rift Valley 22. C. ninagongensis
 Leaves 6 - 9 mm. wide; mountains east of the Rift Valley 23. C. longipedunculata
24. Spikes brown; bracts hairy on the nerves 25
 Spikes yellowish or pale green 26
25. Crater highlands of Tanganyika 24. C. phragmitoides
 Eastern highlands of Kenya 25. C. taylori
26. Spikelets very densely packed; utricles
 3 mm. long 26. C. pseudosphaerogyna
 Spikelets loosely packed; utricles
 4 mm. long 27. C. cognata

1. C. monostachya A. Rich. (Figs. 13, 14)

Stiffly erect tufted perennials, about 18 ins. high, often forming 'stilts' Wet Alpine grassland, 9,000 - 15,000 ft.

KENYA - Kenya and Aberdare Mountains.

TANGANYIKA - Kilimanjaro.

2. C. runssoroensis K. Schum. (Fig. 15)

Tufted perennial forming tussocks up to 3 ft. high. Leafless.

Very similar to the above. Wet montane grasslands 11,000 - 13,000 ft.

UGANDA - Virunga Mts., Ruwenzori Mts., Mt. Elgon.

var. aberdarensis Kuk. differs in the white hyaline margins to the bracts and is more slender.

KENYA - Kenya and Aberdare Mountains.

3. C. conferta A. Rich. var. leptosaccus (C.B.Cl.) Kuk. (Figs. 18, 19)

Short tufted plants $\frac{1}{2}$ - 2 ft. high. Montane moorland and swamps 8,000 - 12,000 ft. The typical form of the species, known from Ethiopia, has shorter beaked utricles, but is otherwise indistinguishable.

KENYA - Naro Moru, Ol Joro Orok, Nyiru, Aberdare and Elgon Mountains.

TANGANYIKA - Kilimanjaro.

UGANDA - Mt. Mgahinga.

4. C. lycurus K. Schum. (Fig. 17)

Stout tufted perennial 2 - 4 ft. high. Leaves broad.

Inflorescence pale brown. Mostly in shady places, forests, stream banks, or upland swamp grassland at 7,000 - 10,000 ft., but down to 4,500 ft. in the Usambara Mountains.

KENYA - Cherangani Hills, Kinangop, Molo.

TANGANYIKA - Crater Highlands, Usambara Mts., Mufindi.

5. C. erythrorrhiza Boeck. var. scabrida Kuk. (Fig. 16)

Narrow leaved tufted sedge 1 - 2 ft. high. In swamps, bamboo and montane forests 10,000 - 12,000 ft., rarely lower. So far only the variety is known from East Africa.

KENYA - Mt. Kenya, Cherangani Hills.

TANGANYIKA - Crater Highlands.

UGANDA - Mt. Mgahinga.

6. C. spicato-paniculata C.B.Cl. (Fig. 23)
 Tufted perennial very like C. chlorosaccus but differing in the usually denser and browner inflorescence, the absence of awns and the scabrid utricles. 3,000 - 6,000 ft.
 TANGANYIKA - Mlinga Peak (Usambara), Iringa District, Kigogo.

7. C. echinochloe Kunze (Fig. 27)
 Tufted perennial 2 - 3 ft. high with a rather dense inflorescence. High rainfall grasslands, bush and Combretum savannah.
 KENYA - Kitale.
 TANGANYIKA - Arusha, Kilimanjaro, Usambara Mts.
 UGANDA - Fort Portal, Kigezi.

8. C. chlorosaccus C.B.Cl. (Figs. 25, 26)
 Tufted leafy perennial 2 - 3 ft. high. Glumes aristate, green or yellowish becoming pale brown like the utricles.
 Forests, 6,000 - 8,000 ft., rarely lower.
 KENYA - Trans Nzoia, Aberdares, Kericho, Mau, Mt. Elgon, Chyulu Hills.
 TANGANYIKA - Mufindi, Kilimanjaro, Ngorongoro, Pare and Usambara Mountains.
 UGANDA - Bugishu.

9. C. castanostachya K. Schum. (Fig. 24)
 Tufted leafy perennial 4 ft. high with a fairly dense paniculate inflorescence. Bracts chestnut brown, utricles very dark, curved. 6,500 - 7,500 ft.
 TANGANYIKA - Uluguru, Usambara and Pare Mountains.

10. C. papillosissima Nelm. (Fig. 29)
 Stout tufted perennial up to 4 ft. high. Spikes numerous. Utricles very broad, dark brown, with a very short beak.
 Forests, 5,000 - 6,000 ft.
 TANGANYIKA - Sao Hill.

11. C. bequaertii De Wild. (Fig. 28)
 (C. petitiana auctt. non A. Rich.)
 Tussock perennial 3 - 4 ft. high with long broad leaves. Inflorescence of 6 - 8 dense pedunculate spikes, the upper 1 to 3 male only, the rest female, long, and 8 mm. broad.
 Wet grasslands, swamps, forest edges and stream banks, 9,000 - 12,000 ft.
 KENYA - Elgon, Kenya and Aberdare Mountains.
 TANGANYIKA - Crater Highlands, Southern Highlands.
 UGANDA - Virunga Mts., Kigezi.

12. C. johnstonii Boeck. (Fig. 30)
 Tufted perennial 2 - 3 ft. high with very narrow spikes. Utricles 8 - 9 mm. long and inflated. Bamboo and upland forests, 7,000 - 10,000 ft.
 KENYA - Elgon and Aberdare Mountains, Kericho, Mau Forest.
 TANGANYIKA - Oldeani, Kilimanjaro, Usambara and Uluguru Mountains.

13. C. vallis-rosetto K. Schum.
 Tufted perennial 2 - 3 ft. high with 8 - 12 androgynous spikes. Utricles 5 mm. long, few nerved, conspicuously bent at the base of the beak.
 TANGANYIKA - Usambara and Uluguru Mountains.

14. C. greenwayi Nelmes (Fig. 33)
Very close to the above. The main differences lie in the more numerous spikes (about 12) and the very straight utricle. Montane and bamboo forests, swampy places, 5,000 - 11,000 ft.
KENYA - Kenya and Aberdare Mountains, Mau Forest.
TANGANYIKA - Meru, Kilimanjaro and Uluguru Mountains.
15. C. mildbraediana Kuk. (Fig. 34)
3 - 6 ft. high perennial of wet montane forests and water pools, at about 8,000 ft.
UGANDA - Karamoja, Ruanda.
16. C. cyrtosaccus C.B.Cl. (Fig. 35)
Tufted perennial 1½ - 2 ft. high, similar to C. fischeri but with larger utricles. In forest, 6,000 - 7,000 ft.
TANGANYIKA - Southern Highlands. Also Nyasaland.
17. C. elgonensis Nelmes (Figs. 38, 39)
Tufted perennial 1 - 2 ft. high similar to C. cuprea but with shorter dark red androgynous spikes. In ericaceous and Hypericum scrub 10,000 - 11,000 ft.
KENYA - Elgon, Kenya and Aberdare Mountains.
18. C. manni E.A. Bruce
(C. boryana auctt. pro parte)
Tufted perennial 2 - 3 ft. high. Leaves up to ¼ in. wide. Upper spike male, rarely female at the base, the others female with a few male spikelets at the top. Alpine grasslands and thickets etc. over 10,000 ft.
UGANDA - Ruwenzori.
19. C. simensis A. Rich. (Fig. 40)
Stout tufted perennial 1½ - 2 ft. high with broad leaves. Upper spike or spikes male, the lateral ones female or with a few male spikelets at the top. Fertile glumes black. Utricles green, shortly beaked, bidentate, 4 - 5 mm. long. Alpine grasslands, Hypericum thicket, swampy ground, 11,000 - 13,000 ft.
KENYA - Elgon, Kenya and Aberdare Mountains.
20. C. fischeri K. Schum. (Figs. 31, 32)
Tufted perennial with green and brown spikes 2 - 3 ins. long. Uppermost spike male, often with some female spikelets near the top. The lateral spikes female throughout. Ericaceous thicket, forest, valley and ravine scrub, often on swampy ground, 8,000 - 11,000 ft.
KENYA - Occurs on all mountain ranges.
21. C. cuprea (Kuk.) Nelmes (Figs. 36, 37)
Common tufted perennial 2 - 3 ft. high with several chestnut brown spikes 2 ins. long. Bracts chestnut with conspicuous green keels. Upland grasslands, swamps and stream sides, 8,000 - 9,000 ft.
KENYA - Kinangop, Ol Joro Orok, Mau.
UGANDA - Kigezi.
22. C. ninagongensis (Kuk.) Robyns (Fig. 41)
Tufted perennial 2 - 3 ft. high, with leaves under ¼ in. wide. Spikes 2 ins. long. Swamps, forest and Hypericum thicket, 10,000-12,000 ft.
KENYA - Mt. Elgon.

23. C. longipedunculata K. Schum.
Tufted perennial with 2 in. long spikes scarcely distinct from the above except for the $\frac{1}{4}$ - $\frac{1}{2}$ in. wide leaves. Swampy stream banks about 8,000 ft.
KENYA - Aberdare Mts., Mau Forest.
TANGANYIKA - Kilimanjaro.
UGANDA - Mt. Mgahinga.
24. C. phragmitoides Kukenth.
Tufted perennial over $1\frac{1}{2}$ ft. high with 4 - 5 brown spikes about $1\frac{1}{2}$ ins. long. Bracts hairy, awned, much longer than the utricles.
TANGANYIKA - Crater Highlands.
25. C. taylori Nelmes
Tufted perennial very similar to the above.
KENYA - Aberdare Mountains.
I have not been able to examine material of either of these species but from a comparison of the rather inadequate descriptions it would seem that they are possibly synonymous, in which case C. phragmitoides is the name which should be used.
26. C. pseudosphaerogyna Nelmes (Fig. 22)
Tufted perennial 2 - 3 ft. high. Very similar to C. cognata.
UGANDA - Ruwenzori and Virunga Mountains.
27. C. cognata Kunth (Figs. 20, 21)
Densely tufted perennial 2 - 3 ft. high with short thick yellowish spikes. Stream banks in forest or plateau grasslands.
TANGANYIKA - Southern Highlands.

SCHOENOXIPHIMUM Nees

This predominantly South African genus of about 15 species has only three known representatives in East Africa, in each case representing the northern limit of distribution of a species better known from Nyasaland and the Transvaal. The majority of the southern species are stout plants 2 to 3 ft. high, but the ones represented here are characterised by slender, very leafy culms which in the field can be readily mistaken for grasses unless in flower. The normal habitats are damp forests and wooded or open grasslands.

The inflorescence is similar to a depauperate Carex with short distant androgynous lateral spikelets, but the two genera are distinguished by the lesser reduction of the fertile spikelets in Schoenoxiphium where it is rare for all the fertile spikelets to be reduced to the nutlet-bearing flower; some of them at least have 4 - 6 staminate flowers above the female flower which protrude from the mouth of the utricle. However, care must be taken as it does sometimes happen that reduction is complete on a particular plant. It is unusual for Schoenoxiphium to occur at the higher altitudes (over 7,000 or 8,000 ft.) where Carex usually occurs.

Key to Species

1. Bracts twice as long as the utricles, awned...1. S. caricoides
 Bracts as long as the utricles or slightly
 shorter 2
2. Utricles 2 - 3 mm. long including the
 $\frac{1}{2}$ - $\frac{3}{4}$ mm. long beak 2. S. sparteum
 Utricles 4 - 5 mm. long, including the
 1 - $1\frac{1}{2}$ mm. long beak 3. S. lehmannii

1. S. caricoides C.B.Cl. (Fig. 46)

(= *Carex dregeana* Kunth, *Schoenoxiphium kunthianum* Kuk.)

An erect shortly rhizomatous perennial 10 - 15 ins. high with yellow-green foliage. Inflorescence a narrow, scanty panicle. Fertile spikelets mostly reduced to the fertile floret only. Damp wooded or open grasslands. 6,000 - 7,000 ft.

KENYA - Trans Nzoia, Kericho.

2. S. sparteum (Wahlenb.) Kuk. (Figs. 42-44)

Erect tufted perennial 1 - 2 ft. high. Inflorescence with numerous pedunculate panicle branches. Forest edges and damp upland grasslands, rarely below 6,000 ft.

KENYA - East Wall of the Rift Valley.

TANGANYIKA - Usambara Mts., Southern Highlands.

UGANDA - Kigezi, Karamoja.

3. S. lehmannii (Nees) Steud. (Fig. 45)

(*S. sparteum* var. *lehmannii* auctt, *Carex uhligii* C.B.Cl.)

Very similar to the above, but with a more scanty inflorescence with subsessile lateral panicle branches. Damp places in evergreen forest, 3,500 - 6,500 ft.

KENYA - Marsabit, Ngong, Mau Forest.

TANGANYIKA - W. Usambara Mts., Kilimanjaro, Bukoba District.

UGANDA - Karamoja.

(Received 15th September 1962)

CYPERACEAE OF EAST AFRICA

Explanation of Figures

PLATE I

- Fig. 1. Diagrammatic spikelet of Cyperus esculentus: a. sterile glume, b. fertile glume, c. rhachilla, d. stamen filament, e. anther, f. ovary, g. style, h. stigma.
 Fig. 2. Coleochloa abyssinica - ♀ floret: b. fertile glume, k. utricule, l. hypogynous bristles.
 Fig. 3. Carex cyrtosaccus - ♀ spikelet: h. stigma, i. bract, k. utricule.
 Fig. 4. Ascolepis anthemiflora - ♀ floret: b. fertile glume, f. ovary, m. fused hypogynous scales (2).
 Fig. 5. Rhynchospora corymbosa - ♀ floret: b. fertile glume, f. ovary, g. style, l. hypogynous bristles.
 Fig. 6. Schoenoxiphium sparteum - ♂ spikelet: i. bract, k. utricule, n. glumes of ♂ florets, o. anthers.
 Fig. 7. Solitary spikelet - Fimbristylis monostachya;
 Fig. 8. Umbel - Mariscus cyperoides.
 Fig. 9. Panicle - Scleria glabra.
 Fig. 10. Dense head of spikes (3) - Kyllinga odorata.
 Fig. 11. Capitulum - Ascolepis anthemiflora.
 Fig. 12. Pseudo-lateral head - Scirpus mucronata.

PLATE II

- Figs. 13, 14. Carex monstachya.
 Fig. 15. Carex runssoroensis.
 Fig. 16. Carex erythrorrhiza var. scabrida.
 Fig. 17. Carex lycurus.
 Figs. 18, 19. Carex conferta var. leptosaccus.
 Figs. 20, 21. Carex cognata.
 Fig. 22. Carex pseudosphaerogyna.

Inflorescences x ½, utricles x 4.

PLATE III

- Fig. 23. Carex spicato-paniculata.
 Fig. 24. Carex castanostachya.
 Figs. 25, 26. Carex chlorosaccus.
 Fig. 27. Carex echinochloe.
 Fig. 28. Carex bequaertii.
 Fig. 29. Carex papillosissima.
 Fig. 30. Carex johnstonii.
 Figs. 31, 32. Carex fischeri.
 Fig. 33. Carex greenwayi.
 Fig. 34. Carex mildbraediana.
 Fig. 35. Carex cyrtosaccus.

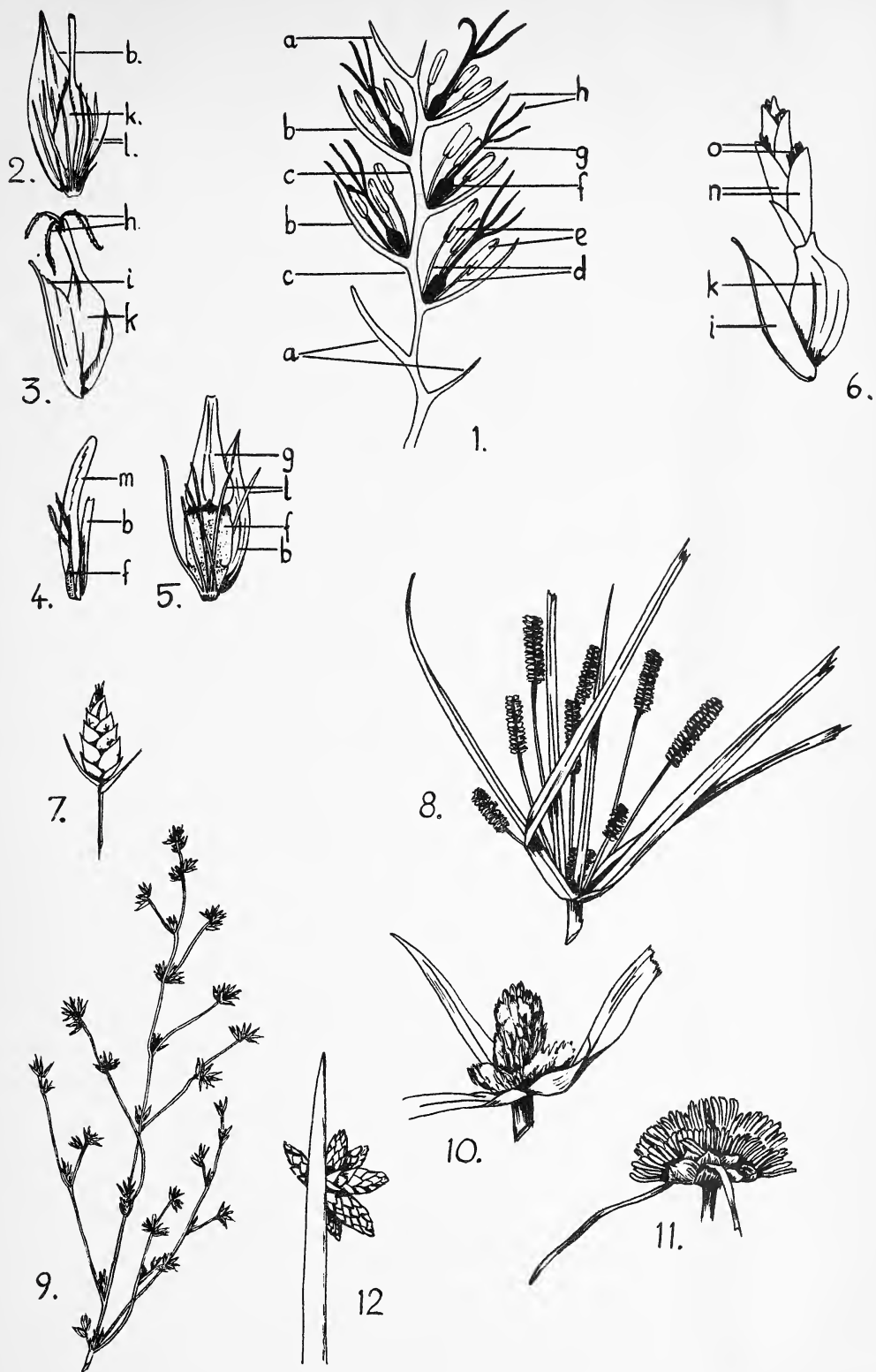
Inflorescences x ½, utricles x 4.

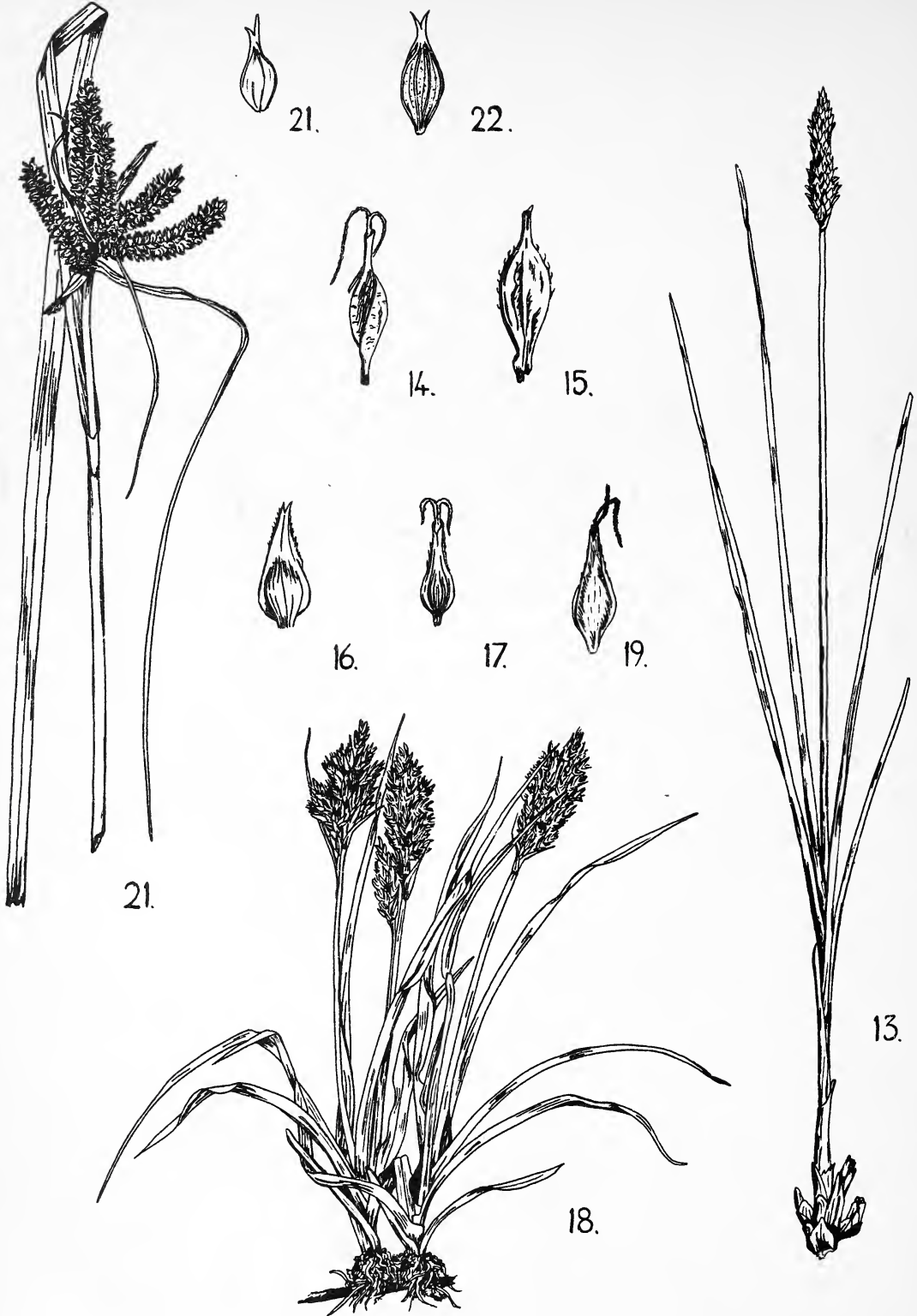
PLATE IV

- Figs. 36, 37. Carex cuprea.
 Figs. 38, 39. Carex elgonensis.
 Fig. 40. Carex simensis.
 Fig. 41. Carex ninagongensis.
 Figs. 42, 43, 44. Schoenoxiphium sparteum.
 Fig. 45. Schoenoxiphium lehmannii.
 Fig. 46. Schoenoxiphium caricoides.

Inflorescences x ½, utricles x 4.

m. ♂ portion of spike, s. flowers protruding from utricule, u. utricles.





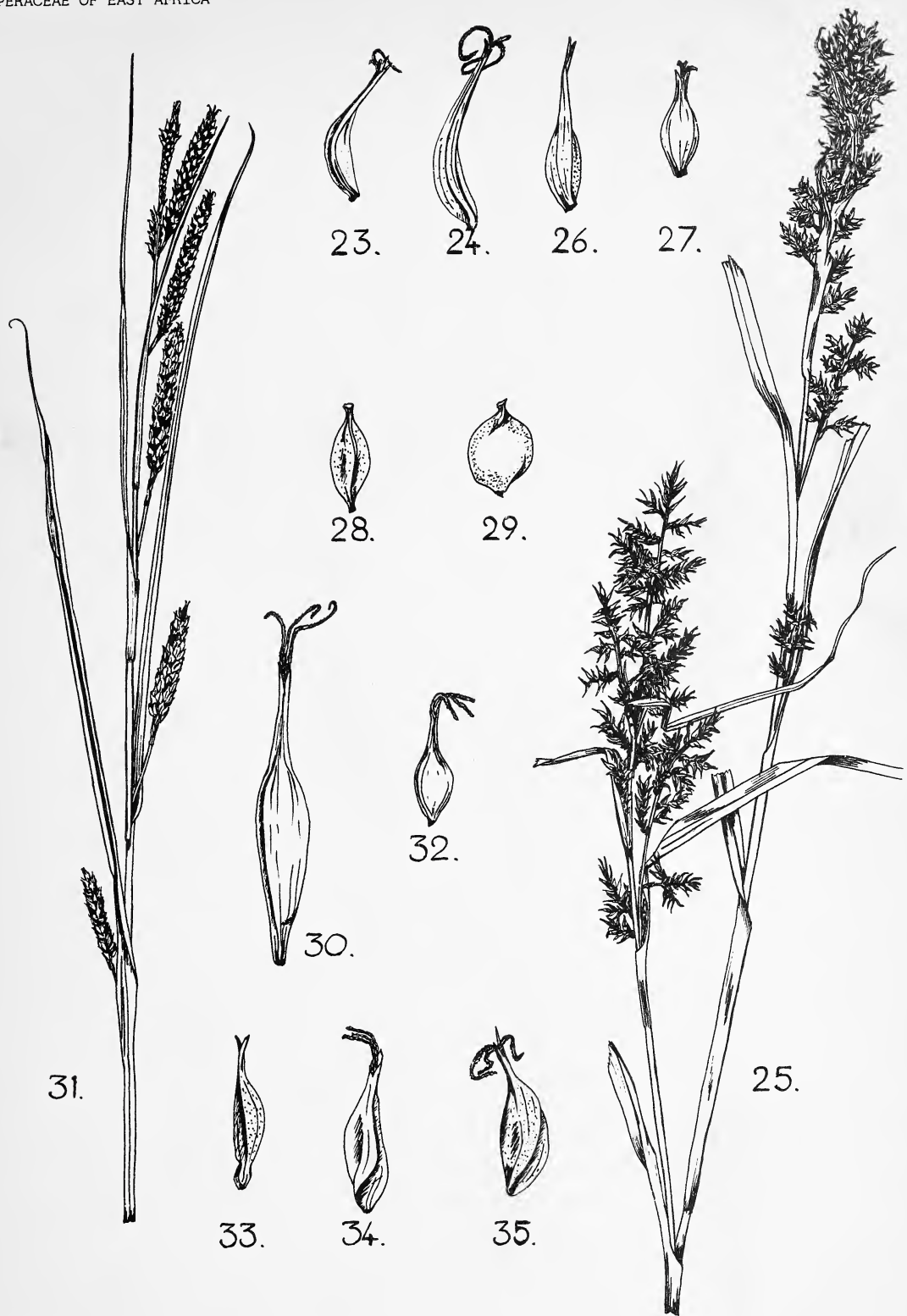




PLATE IV

THE MILKWEED BUTTERFLIES OF EAST AFRICA

(LEPIDOPTERA, DANAIDAE)

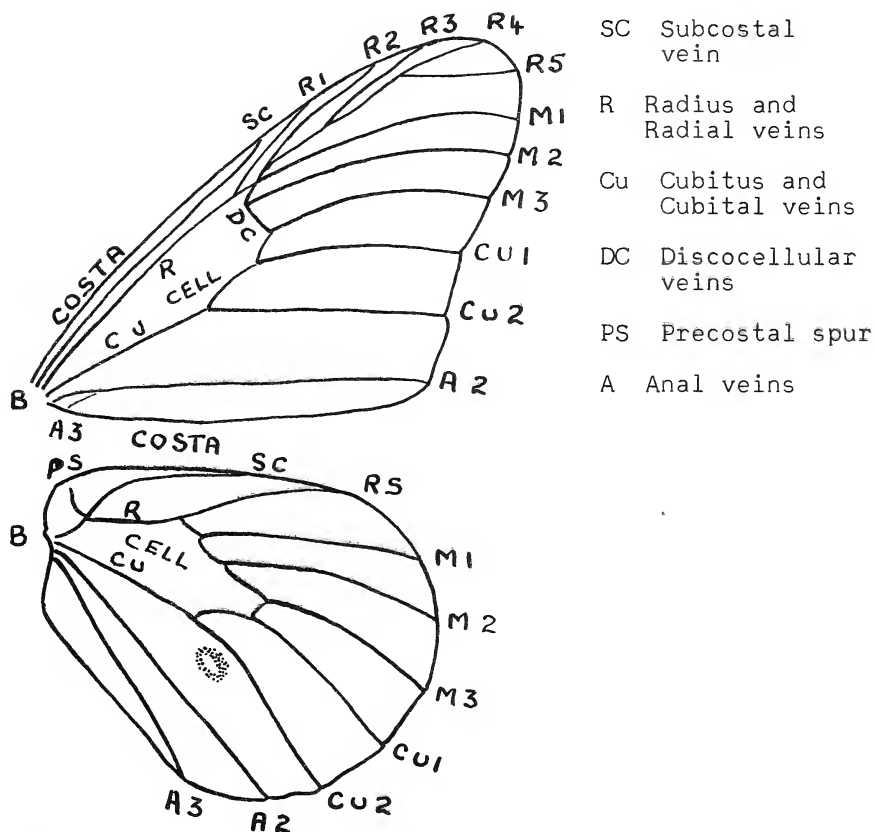
by

R.H. CARCASSON
(Coryndon Museum, Nairobi)

ABBREVIATIONS

Abbreviations used in this paper are as follows:

fw	=	forewing	uns	=	underside
hw	=	hindwing	ups	=	upperside

Venation of genus Danaus

Family DANAIIDAE

Medium to large butterflies of pantropical distribution and particularly well developed in the Oriental region. The genitalia of the males are often provided with retractile scent brushes and scent brands are present on the hindwing of the males of most African species.

The Danaidae may be separated from other families by the branched condition of vein A2 at the base of the forewing. All members of the family are distasteful to vertebrate predators and are used as models by many mimetic species of other groups.

The Larvae are smooth, cylindrical and decorated with long fleshy filaments on the dorsum and frequently feed on plants of the family Asclepiadaceae. The pupae are rounded and obtuse, usually decorated with metallic silver and attached by the anal end. Twenty-six species of this group are known to occur in the Ethiopian Region.

Key to the genera of East African DANAINAE

Vein R2 of fw arises from or beyond upper end
of cell Danaus

R2 of fw arises from well before upper end of cell Amauris

Genus DANAUS Klug. 1802

Large, brightly coloured butterflies, particularly numerous in the Oriental tropics. There is a prominent pouch between Cu2 and A2 of the hindwing in the males.

Key to the East African Species of the genus Danaus

1. Ground colour orange brown with white and
black markings 2
2. Apical area of fw black, subapical white
bar present D. chrysippus f. chrysippus
- 2a. Apical area of fw orange brown bordered
with black; no subapical white bar.... D. chrysippus f. dorippus
3. Ground colour black; numerous pale spots..... 4
4. No orange brown or dark red brown areas;
markings pale bluish white D. limniace petiverana
- 4a. Basal area of fw orange brown; markings
creamy white D. formosa formosa
- 4b. Basal area of fw dark red brown; markings
creamy white D. formosa mercedonia

Danaus chrysippus Linnaeus (Syst. Nat. Ed. 10 p.471, 1758)

A very common species; the nominate race occurs throughout the Ethiopian region, in India, and in the Eastern Mediterranean. It is seldom seen in forest, but is otherwise ubiquitous in East Africa. There are distinct races in the East Indies and in Australia. The typical form chrysippus L. is orange brown with a black tip and a white subapical bar on the fw and a black margin to the hw; the form alcippus Cramer is similar, but has a large white area in the centre of the hw; the form dorippus Klug lacks the black apex and white bar of the fw, and the form albinus Lang is similar to dorippus, but has a white area in the hw. Chrysippus is the dominant form in Southern Africa and in the Orient, alcippus in West Africa and dorippus in East Africa; albinus occurs sparingly with dorippus.

Subgenus TIRUMALA Moore 1880Danaus (Tirumala) limniace Cramer (Pap. Exot. I : 92, 1775)

Subspecies petiverana Doubleday & Hewitson (Gen. Diurn. Lep. I : 93, 1847)

DESCRIPTION A large black butterfly with numerous bluish white markings.

RANGE petiverana is the African race, the nominate race being Oriental. It is common over most of the Ethiopian region but does not occur in South Africa and Madagascar. In East Africa it is very generally distributed and particularly common in Marsabit and in the coastal forests, where it appears to replace the following species. Partial to wooded country, but not necessarily forest.

Subgenus MELINDA Moore 1883Danaus (Melinda) formosa Godman (Proc. Zool. Soc. 1880, p.3)

A fairly common forest species ranging from West Africa to Kenya, Tanganyika and Ethiopia. The two East African races have been regarded as distinct species by some authors, but must be considered conspecific, as their genitalia are practically identical and their range does not overlap, except in a small area.

Subspecies formosa Godman

DESCRIPTION Basal half of fw orange brown, distal half black with white spots; hw black with large white area at the base and numerous white spots.

RANGE High forest in N.E. Tanganyika and in Kenya from Teita to Kakamega.

RECORDS Kenya: Nairobi, Thomson's Falls, Wandanyi, Sagana River. (Nyeri), Meru, Teita, Tiriki, Chyulu Hills, Kakamega, Kitale.
Tanganyika: Amani (Usambara), Tengeru (Arusha).

Subspecies mercedonia Karsch (Ent. Nachr. 20 p.228, 1894)

DESCRIPTION White markings fewer and smaller than previous sub-species; orange area of fw smaller and much darker.
 RANGE Kenya west of the Rift Valley to Uganda, E. Congo and N.W. Tanganyika.
 RECORDS Uganda: Jinja, Mubende, Kalinzu Forest (Ankole). Kibale Forest (Toro), Bwamba, Ndurumu River (Ankole), Kampala, Entebbe, Mbale.
Kenya: Kakamega, Kapsabet, Malawa Forest, Kitale.
Tanganyika: No records, but certain to occur in the extreme North West.
 NOTE The two races overlap in the Nandi-Elgon area of W. Kenya, where occasional hybrids have been recorded.

Genus AMAUROS Hubner 1816

A group of about 20 species confined to the Ethiopian region. The males have a mealy patch on both sides of A2 of the hw, but no pouch. In the subgenus Panamauros Bryk, RS and MI of the hw are contiguous at the base.

Key to the East African species of Amauris

1. RS and MI of hw contiguous at base 9
 - Base of MI equidistant from RS and M2 2
2. All markings white on black ground colour 3
 - Discal area of hw yellowish 6
3. Very broad subapical bar; margin of hw unspotted.... A. niavius
- 3a. Subapical bar narrow or broken; hw margin spotted with white 4
4. White basal area of hw below reaches SC 5
 - 4a. White basal area of hw below does not reach SC A.hecate
5. White discal band of fw broken; mealy spot on hw of male small A. tartarea
- 5a. Discal band of fw usually entire; mealy spot large A. ochlea
6. White spot on second segment of palpi below 7
 - 6a. White stripe on second segment of palpi below 8
7. Yellowish area of hw below well defined from Cu2 to inner margin A. echeria

- 7a. Yellowish area of hw below not well defined from Cu2 to inner margin A. oscarus
8. Dark basal area of hw below invades basal third of cell A. albimaculata
- 8a. Dark basal area of hw below barely enters base of cell A. inferna
9. All markings ochreous yellow A. ansorgei ellioti
- 9a. Markings of fw white A. ansorgei (all other races)

Amauris niavius Linnaeus (Syst. Nat. Ed. 10 p.470, 1758)

RANGE Common in forests throughout Africa, but not in Madagascar. Usually not found above 5,000 ft.

Subspecies niavius Linnaeus

DESCRIPTION Large, black and white.

RANGE Africa West of the Rift Valley, excluding Ethiopia.

RECORDS Tanganyika: Ukerewe Island (Lake Victoria), Kigoma.

Kenya: Kakamega, Kitale, Kaimosi.

Uganda: Kalinzu (Ankole), Kayonza (Kigezi), Entebbe, Kampala, Bwamba, Katera, Budongo, W. Elgon, Mabira, Bugoma forest, Mawakota, Chagwe.

Subspecies dominicanus Trimen (Trans.Ent.Soc.Lond. 1879)

DESCRIPTION All white markings more extensive than in typical race.

RANGE Kenya East of the Rift Valley to Nyasaland, Rhodesia and South Africa.

RECORDS Kenya: Msambweni, Diani, Vanga, Kilifi, Mombasa, Kibwezi, Teita Hills, Chyulu Hills, Mutha Hill, Marsabit, Wandanyi, Kwale, Nairobi, Mt. Kulal.

Tanganyika: Tengeru (Arusha), Amani (Usambaras), Moshi, Morogoro.

Uganda: Recorded by V.G.L. van Someren at Bufumbo, W. Elgon.

Subspecies aethiops Rothschild & Jordan (Nov. Zool. 10, p.503, 1903)

DESCRIPTION Very similar to the typical race; subapical bar shorter and narrower.

RANGE Ethiopia to S.E. Sudan and N. Uganda.

RECORDS Taken in Karamoja, N.E. Uganda by V.G.L. van Someren.

Amauris tartarea Mabille (Bull. Soc. Zool. Fr. I p. 199, 1876)

RANGE Common in forests up to 6,000 ft.; occurs throughout most of Africa but not in Ethiopia, South Africa or Madagascar.

Subspecies tartarea Mabilie

DESCRIPTION A large black and white species; may be distinguished from A. ochlea by the broken median band of the fw and from A. hecate by the greater development of the white markings of the hw.

RANGE Sierra Leone to Angola and Kenya West of the Rift Valley.

RECORDS Kenya: West Nandi, Kakamega, Malawa forest, Kaimosi, Tiriki, Suna (Kisii).
Uganda: All forests up to 5,000 ft.
Tanganyika: Ukerewe Island. Certain to occur elsewhere in the North-West of the territory.

Subspecies damoclide Staudinger (Iris 8, p. 367, 1896)

DESCRIPTION Central white area of hw much larger than in typical race.

RANGE Eastern Tanganyika to North Nyasa.

RECORDS Tanganyika: Moshi, Turiani (Morogoro), Himo.

Amauris ochlea Boisduval (Voy. Deleg. 2, p.589, 1847)

RANGE Lowland and coastal forests of Eastern Africa, from Natal to Somalia.

Subspecies ochlea Boisduval

DESCRIPTION Smaller than the preceding species; median white band of fw entire in most races, central white area of hw large and well defined.

RANGE Kenya East of the Rift Valley to Natal; replaced by other races further North.

RECORDS Kenya: Mombasa, Kwale, Rabai, Marsabit, Kibwezi, Voi, Sekoke Forest, Tana river, Teita, Meru, Mt. Kulal.

NOTE Specimens from Meru and Kulal have a very dark uns. and approach ssp. darius Rothschild & Jordan, 1903 from S. Ethiopia.
Tanganyika: Amani, Mtwara, Segoma.

Subspecies bumilleri Lanz (Iris 8, p. 380, 1896)

DESCRIPTION Differs from other races in having the median band of the fw broken.

RANGE Between Lakes Tanganyika and Nyasa according to Aurivillius, and in Western Tanganyika according to Talbot. Baka River, between N. Langenburg and Mwaya (S.A. Neave).

Amauris hecate Butler (Proc. Zool. Soc. Lond. 1866, p.44)

RANGE Forests from Sierra Leone to Uganda and W. Kenya. It is represented in Ethiopia by ssp. stictica Roths. & Jordan. (Nov. Zool. 10, p. 504, 1903)

Subspecies hecate Butler

- DESCRIPTION Fairly large; black and white, with white markings of hw much reduced.
- RECORDS Kenya: Kakamega, Tiriki, Kitale, Kaimosi.
Uganda: All forests up to 5,000 ft.
- NOTE A. dira Neave, in which the white spot in the fw cell is very much reduced or absent, is treated here as an aberration of A. hecate.

Amauris inferna Butler (Proc. Zool. Soc. Lond. 1871, p. 79)

RANGE Forests in West Africa, the Congo and Uganda.

Subspecies inferna Butler

RANGE Cameroons, Gaboon.

Subspecies groqani E. Sharpe (Ann. Mag. Nat. Hist. (7) 8, p.278, 1901)

- DESCRIPTION Fw black with white spots; hw black with a reduced yellowish discal area gradually merging with dark ground colour; dark basal area of hw reduced.
- RANGE Very little is known about the distribution of this race.
- RECORDS Has been taken in the Kayonza forest, Kigezi, Uganda, by T.H.E Jackson and V.G.L. van Someren. Also in Kalinzu, (Ankole).

Subspecies uganda Talbot (Trans.R. Ent. Soc. Lond. 90: 319-336, 1940)

- DESCRIPTION Very similar to above; pale markings not so restricted.
- RANGE Uganda.
- RECORDS Katera (Masaka), Kampala, Bwamba, Mawakota, Jinja.

Amauris echeria Stoll (Suppl. Cram. p.135, 1790).

RANGE Forest and heavy woodland in the Cameroons, Congo, Ethiopia, East Africa, Rhodesia and South Africa.

Subspecies echeria Stoll

RANGE South Africa.

Subspecies septentrionis Poulton (Proc. Ent. Soc. Lond. 1924, p.26)

- DESCRIPTION Ground colour dark smoky brown; all pale markings ochreous; hw discal area very broad.
- RANGE Marsabit, Mt. Kulal and the Uaso Nyiro, in the Northern Province of Kenya.

Subspecies serica Talbot (Trans.R.Ent.Soc.Lond. 90: 319 - 336, 1940)

- DESCRIPTION Very large; all spots of fw and marginal spots of hw pure white and large; ground colour velvety black.
- RANGE N. Nyasa to S. Tanganyika.

The Milkweed Butterflies of East Africa

RECORDS Tanganyika: Mhonda, Itumba, Mt. Rungwe (Mbeya),
 Ufipa, Turiani.

Subspecies kikuyu Talbot (op. cit., 1940)

DESCRIPTION	A large race with very dark uns and pure white spots.
RANGE	Kenya Highlands East of the Rift Valley.
RECORDS	Thika, Meru, Uplands, Mt. Kenya, Nyeri, Njombeni, Aberdares, Nanyuki.

Subspecies *meruensis* Talbot (op. cit., 1940)

DESCRIPTION	Very similar to above, but median band of hw narrower, spots mixed with pale ochreous.
RANGE	North-Eastern Tanganyika.
RECORDS	Kondoa, Namanga, Gonja, Lake Duluti, Tengeru, Ngare-Nairobi, Arusha, Moshi, Lake Manyara, Ngaruka, Kitanga, Ngorongoro.

Subspecies jacksoni E. Sharpe (Proc.Zool.Soc.Lond. 1891, p.633)

DESCRIPTION	Intermediate between <u>kikuyu</u> Talbot and <u>contracta</u> Talbot.
RANGE	Kenya Highlands, West of the Rift Valley.
RECORDS	Kenya: Lumbwa, Kericho, Sotik, Suna (Kisii).

Subspecies chyuluensis van Someren (J.E.Afr.Ug.Nat.Hist.Soc. 14, 1939)

DESCRIPTION	As above, but white spots of hw larger and more numerous.
RANGE	Chyulu Hills, Teita Hills and Emali range, in S.E. Kenya.

Subspecies contracta Talbot (op. cit., 1940)

DESCRIPTION	Smaller, with pale markings less developed than above, uns rather paler than previous races.
RANGE	W. Kenya and E. Uganda.
RECORDS	<u>Kenya</u> : Mt. Elgon, Kitale, Kabernet, Kakamega, Cherangani, Sotik, Kisii, Kaimosi, Tiriki.
	Uganda: Mbale, Tororo, Mabira, Jinja.

Subspecies *terrena* Talbot (op. cit., 1940)

DESCRIPTION	Similar to above, but generally larger.
RANGE	W. Uganda, N.E. Congo.
RECORDS	<u>Uganda</u> : Mafuga Forest (Kigezi), Kalinzu Forest (Ankole) Kanaba, Bwamba, Namwambe Valley (Ruwenzori), Kayonza (Kigezi).

Subspecies mongallensis Carpenter 1928.

DESCRIPTION	Similar to <u>septentrionis</u> Poulton, but fw markings white, hw basal area a little darker, submarginal spots well developed.
RANGE	South Sudan.
RECORDS	Uganda: Madi Opei (Karamoja.)

Amauris albimaculata Butler (Ann.Mag.Nat.Hist. (4) 16, p.394, 1875)

RANGE Tends to frequent higher altitudes than the previous species. Forests from Natal to Kenya and the S. Sudan in the North and to the E. Congo in the West, with an isolated race in the Cameroons.

Subspecies albimaculata Butler

DESCRIPTION Very similar to echeria, but somewhat smaller; fw spots always white; white stripe on uns of palp, not a white spot, as in echeria.

RANGE Natal and Mozambique to S. Tanganyika.

RECORDS Tanganyika: Mhonda.

Subspecies interposita Talbot (op. cit., 1940)

DESCRIPTION As above, but discal spots in fw larger.

RANGE N. Tanganyika to the Kenya Highlands and E. Uganda.

RECORDS Kenya: Nairobi, Limuru, Subukia, Thomson's Falls, Uplands, Nyeri, Bahati Forest (Nakuru), Kitale, Kabernet, Lumbwa, Laikipia, Mt. Kenya, Meru, Elgeyo, E. Aberdares, Kakamega, Sotik.

Uganda: Mbale.

Tanganyika: Lyamungu, Mt. Meru, W. Kilimanjaro.

NOTE Specimens from Namanga (Kenya-Tanganyika Border) appear to belong to a distinct race. Some specimens from Kabernet approach the following race.

Subspecies hanningtoni Butler (Proc.Zool.Soc.Lond., 1888, p.183)

DESCRIPTION Hw very pale, nearly white.

RANGE Coastal areas of Kenya and N. Tanganyika.

RECORDS Kenya: Chyulu hills, Teita hills, Voi, Kibwezi.
Tanganyika: Amani (Usambara), Usango District.

Subspecies maqnimacula Rebel (Ann.Naturh.Hofmus.Wien. 28: 219-265, 1914)

DESCRIPTION All pale areas very large.

RANGE E. Congo and Uganda.

RECORDS Uganda: Katera (Masaka), Jinja, Entebbe, Kagera River, Kalinzu (Ankole), Kibale Forest (Toro), Bwamba, Kayonza, (Kigezi).

NOTE There is a ♂ in the Coryndon Museum collection from near Kigoma, Tanganyika. It has a white hw and may represent an undescribed race.

Amauris oscarus Thureau (Berlin Ent. Zeitschr. 48 p. 301, 1903)

RANGE Forests from W. Kenya and Uganda to the Cameroons in the West and Angola and Nyasaland in the South.

Subspecies oscarus Thureau

DESCRIPTION Similar to the preceding species, but pale markings less extensive; white spot, not stripe on uns of palpi.
 RANGE W. Kenya, Uganda, E. Congo.
 RECORDS Kenya: Kakamega, Tiriki.
Uganda: Entebbe, Kampala, Jinja, Kagera river, Kalinzu (Ankole), Kamengo, Nabugabo, Ndurubu river, Kayonza (Kigezi), Bwamba (Toro).

Subspecies alba Neustetter (Iris 30: 95-108, 1916)

DESCRIPTION As above, but hw white.
 RANGE "Ost Afrika", probably Tanganyika.

Subgenus PANAMAURIS Bryk, 1937

Amauris (Panamauris) ansorgei E. Sharpe (Ann.Mag.Nat.Hist.(6) 18, p.158, 1896)

RANGE An uncommon species of high forest; Nairobi area to Kivu in the West and to Katanga and Nyasaland in the South.

Subspecies ansorgei E. Sharpe

DESCRIPTION Black with deep buff hw and white spots on fw and margin of hw.
 RANGE Kenya West of the Rift Valley and Eastern Uganda.
 RECORDS Kenya: Sotik, Lumbwa, Nandi, Eldama Ravine, Kitale, Mt. Elgon.

Subspecies altumi van Someren (J.E.Afr.Nat.Hist.Soc. 21: 44, 1926)

DESCRIPTION Similar to typical race, but hw generally paler.
 RANGE Mt. Meru, Kilimanjaro and Kenya Highlands East of the Rift Valley.
 RECORDS Kenya: Nairobi, Limuru, Uplands, Mt. Kenya, Kikuyu, Escarpment, Aberdares, Katamayo Forest.

Subspecies junia Le Cerf (Bull.Mus.Nation.Hist.Nat.Paris 26, p.40, 1920)

DESCRIPTION Similar to typical race, but a little smaller and lacks the small marginal white spots in both wings.
 RANGE Nyasaland to Central Tanganyika.
 RECORDS Tanganyika: Itumba, Usango, Morogoro, Takugu, Nuto, Dodoma, Poroto Mts., Mt. Rungwe (Mbeya), Njombe.

Subspecies elliotti Butler (Ann.Mag.Nat.Hist. (6) 16, p.122, 1895)

DESCRIPTION All pale markings bright ochreous yellow.

RANGE Eastern Congo and Western Uganda.

RECORDS Uganda: Toro, Namwambe Valley (Ruwenzori),
Kibale (Kigezi).

NOTE elliotti has been treated as a distinct species by some authors; however its genitalia do not differ from those of other races of ansorgei and its distribution does not overlap that of other races.

(Received 15th. July 1962)



1



2



3



4



5



6

1. *Danaus chrysippus* f. *chrysippus* 2. *D. formosa formosa*
3. *Danaus limniace petiverana* 4. *Amauris niavius niavius*
5. *Amauris ochlea ochlea* 6. *Amauris tartarea damoclides*



7



8



9



10



11



12

- | | |
|------------------------------------|----------------------------------------|
| 7. <i>Amauris hecate hecate</i> | 8. <i>Amauris inferna uganda</i> |
| 9. <i>Amauris oscarus oscarus</i> | 10. <i>A. albimaculata interposita</i> |
| 11. <i>Amauris echeria terrena</i> | 12. <i>Amauris ansorgei altumi</i> |

Index

aethiops	23	inferna	25
alba	28	interposita	27
albimaculata	27		
albinus	21	jacksoni	26
alcippus	21	junia	28
altumi	28		
Amauris	20	kikuyu	26
ansorgei	28		
		limniace	21
bumilleri	24		
chrysippus	21	magnimacula	27
chyuluensis	26	Melinda	21
contracta	26	mercedonia	22
		meruensis	26
damocles	24	mongallensis	26
Danaus	20		
darius	24	niavius	23
dira	25		
dorippus	21	ochlea	24
		oscarus	27
echeria	25		
elliotti	29	Panamauris	28
		petiverana	21
formosa	21		
grogani	25	septentrionis ...	25
		serica	25
hanningtoni	27		
hecate	24	tartarea	23
		terrena	26
		Tirumala	21
		uganda	25

BREEDING OF THE BLACK-HEADED HERON AT NAIROBI, KENYA, 1958-62

By

M.E.W. NORTH

(Photographs 1-16 by the author, two tables, a histogram and a map)

Contents

	Page
I. Introduction	34
II. The nesting site	35
III. Occupation, 1954-8	36
IV. Occupation, 1958-62	40
V. The observation tower, 1960-1	46
VI. Food, foraging and roosts	47
VII. Relationship with other birds	50
VIII. Breeding : early phases	52
IX. Breeding : young birds	55
X. Photography and sound-recording	60
Acknowledgments	61
Summary	62
References	63
Table 1.	38
Table 2.	40

1. Introduction

In 1954, a number of Black-headed Herons, Ardea melanocephala Vigors and Children, appeared at the Stores Yard of the East African Railways in Nairobi and at once began to breed in a clump of tall Eucalyptus trees. The colony prospered, and in 1958 the Committee of the East Africa Natural History Society decided that this was suitable for a detailed study, which has continued ever since and still continues. The organization of the work and most of the watching have been my responsibility and this report summarizes the 4-year period May 1958 to May 1962, plus some additional observations up to the time of going to press in October 1962. The main activity, making a monthly count of occupied nests, was undertaken by me except during part of 1959 when Mr. Leslie Brown kindly took over while I was on leave. In addition to the counts, an attempt was made to study various other aspects of the biology of this species. My observations were necessarily intermittent on account of absences from Nairobi, but over 200 hours' field work has been spent on the investigation to date.

At each monthly count during this period there have been at least some occupied nests, which proves that breeding has been continuous over these four years. It has been remarked that in tropical climates there is no reason why birds should not breed all the year round; here is evidence that they do. It so happens that continuous, less-than-annual or annual breeding on the part of the seabirds of Ascension Island has recently been the subject of an authoritative report by the members of the B.O.U. Centenary Expedition, Stonehouse et al., 1962, and the analytical accounts here given are most relevant for the understanding of similar behaviour in A. melanocephala. Further, Stonehouse, 1962:121 has coined some useful breeding definitions which will be used here. These stem from the dictionary definitions of season as a time of year, period as an amount of time and cycle as a recurrent series of events. Thus, breeding season is the time of year during which breeding activities of any kind take place; laying season, the time of year when individuals of a species normally lay eggs; breeding cycle, the sequence of events which a bird follows from the beginning of courtship to the independence of its offspring, and breeding period, the length of time required to complete the breeding cycle.

The breeding cycle of A. melanocephala is discussed in detail and illustrated by a histogram in Part IV. It is of considerable interest and by no means easy to summarize in a few words; further, four years are a short period and much will no doubt be learnt in the years to come. However, evidence accumulated to date indicates that: (1) Peaks in breeding are linked with rain and lulls with drought. (2) Where rains are exceptional, the result may be a large breeding occupation which persists for many months to come. Whether such persistence is caused by successive broods on the part of resident birds, or by additional birds arriving to breed, or by both, is a matter for speculation. (3) Poor rains result in a small occupation which then dwindles. (4) The period of minimum activity is during the dry weather of August-September after poor rains in April-May.

Although activity nearly ceased twice (both times in August) it never ceased entirely, and in fact there is cause to suspect that breeding at this colony has been continuous ever since it was first occupied in 1954. One year's continuous breeding has recently been proved at a small colony in the grounds of Makerere College, Kampala, Uganda, and it is further suspected that fairly continuous breeding may have been the case at this colony for many years past.

A. melanocephala breeds in colonies which can be exclusive, consisting of this one species only, or mixed, where it breeds with other aquatic birds. The only exclusive colony known to me in Kenya, apart from Nairobi's, is at Kakamega, in the grounds of the hospital. Mixed colonies have been recorded in a few areas, e.g. Kisumu, also the lower Tana River particularly at Garsen. In Uganda Mr. Brown informs me that this species is much commoner than in Kenya, and that there are plenty of colonies of both types. To date, the evidence of continuous breeding is from some exclusive colonies only, and it may well be proved that over Africa generally, seasonal breeding is the commoner.

Apart from the continuous breeding, other interesting features of this investigation include the fact that at the beginning of the breeding cycle the bird's iris changes in colour from yellow to red, (Part VIII), and that it suffers from a habitual predator, an eagle, which takes serious toll of the young, the adults being too frightened to attempt any form of defence, (Part VII). Unfortunately it is not possible to tell the sexes apart in the field, and indeed all normal birds look alike, though there are occasional melanistic individuals with highly distinctive plumage. I owe a curious record to these latter - a pair of normal birds hatched young and then (it seems) deserted them; anyhow, a pair of melanistic birds apparently adopted and reared the surviving chick, (Part IX). It would of course have been most advantageous if birds could have been colour-ringed so that the actions of individuals could be studied, but to date colour-ringing has been considered impractical for various reasons including the height and inaccessibility of the nests, the large number of birds needing to be ringed and the problem, as yet unsolved, how to catch adult birds for ringing.

Certain authorities - Jackson 1938, Lowe 1954, Meyerriicks 1960, Pitman 1927 and Sneyd Taylor 1948 - are constantly cited, so for these an abbreviated method of reference has been used in the text, mentioning author and page only, e.g. Lowe: 67.

Many people have helped this investigation. Their assistance is gratefully acknowledged at the end of this paper.

II. The Nesting Site

To the south-west of Nairobi Railway Station (altitude 5343 ft.) lies the Stores Yard - a large open enclosure with sidings for the deposit and removal of bulky stores which can be kept in the open air, such as rails, pig-iron and drums. The Yard is fenced and constantly patrolled by watchmen, and visitors may enter only with a pass. Over much of the Yard, Eucalyptus trees have been planted, the average height being about 70 ft. It is these which the herons occupied in 1954 and have used ever since. For several reasons

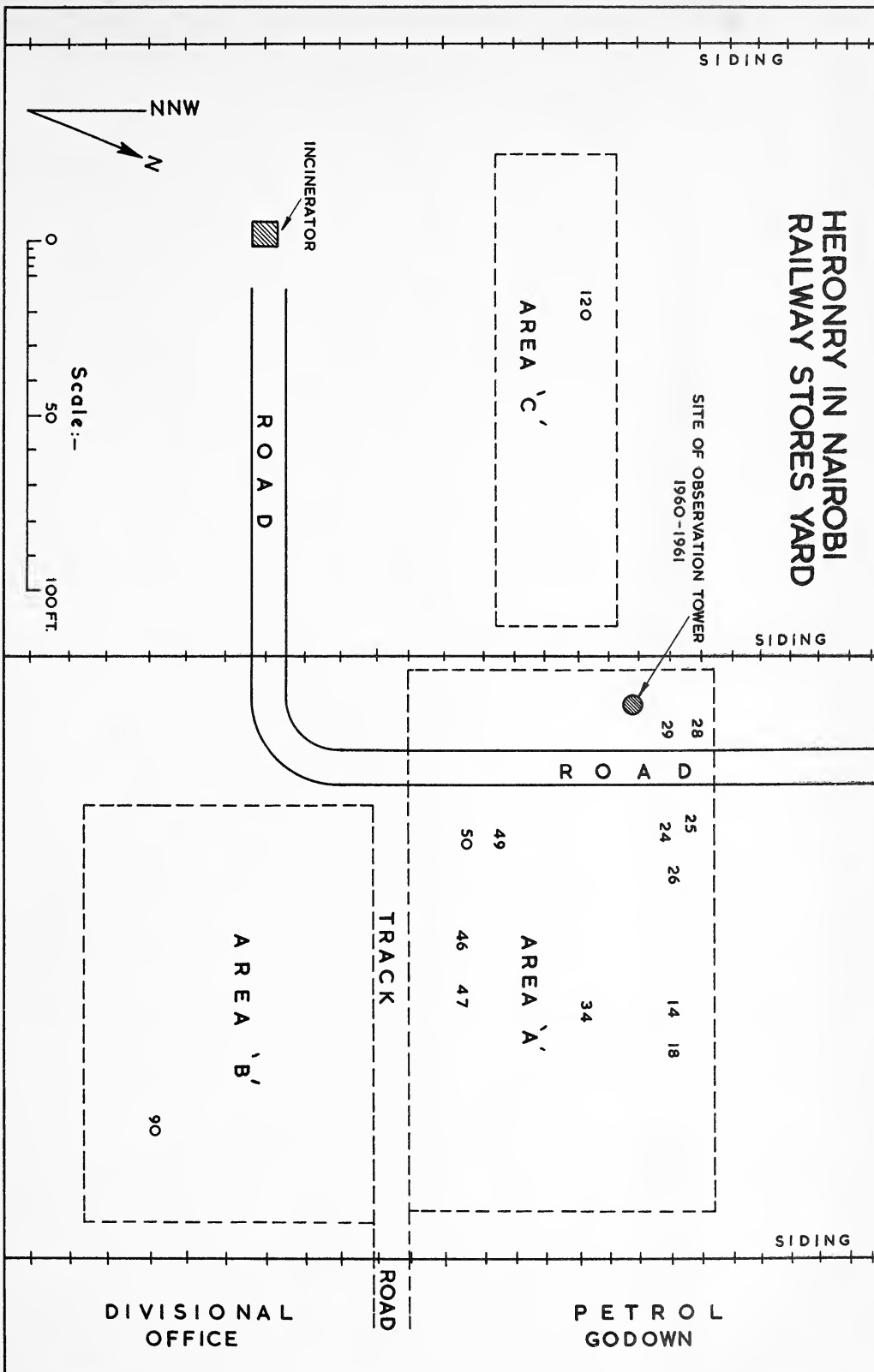
they could hardly have chosen a better site: (1) They have complete freedom from molestation because the Yard is carefully guarded and orders have been issued that the birds shall in no way be disturbed. (2) They are no nuisance to anybody here, in contrast to a colony at Entebbe, Uganda, where, according to Pitman: 27, the pertinacity of the birds in trying to breed in unsuitable places - such as in trees over houses - was unbelievable; in order to get rid of the herons it was usually necessary to lop or cut down the trees. (3) The particular type of gum which our Nairobi birds use - which Mr. Lucas of the East African Herbarium has identified as Eucalyptus camaldulensis Dehn, (Pl. 2, Fig. 6), seems ideal for the purpose, as it provides many excellent nesting crotches at the top, and further, the limbs are flexible and rarely break in strong winds even when loaded with the heaviest nests, nor do these nests cause the branches to wither and die, and there are no thorns to catch young birds. (4) The trees in the vicinity provide an ample supply of nesting sites and nesting materials. (5) The country round Nairobi must be excellent for foraging, otherwise the birds surely could not manage to rear their young at any time of year, even in drought, as they do.

From the watcher's point of view the colony is ideal, because the birds are so accustomed to seeing trains passing by and stores being loaded that they pay no attention to anything which anybody does on the ground, and in particular they even ignore being watched, so can be studied behaving perfectly naturally. They are, however, considerably shy when a person climbs to nest level, (Part V).

The accompanying map shows three breeding areas, "A", "B", and "C". Of these, "A" is the core and "B" and "C" are overflow areas used only at times of high-density breeding. At the start of the investigation any tree likely to carry a nest was labelled with a serial number; fourteen of the most-favoured trees are shown on the map. Area "A" at its highest density - during the short rains of 1961 - had some 120 occupied nests. No single tree had more than 10, which is small compared with the Entebbe heronry where Pitman: 26, 29 states that a single large tree might contain as many as 2 - 3 dozen nests, sociability at nesting time appearing to be essential. The same applies to this colony, though here the birds are obliged to use a number of small trees close together instead of a large one. Since there are plenty of other trees near by, the birds concentrate from choice and not from necessity. Lowe: 71 says that in China, entire heronries of the Grey Heron Ardea cinerea Linn. may be contained in a single tree, but most trees in Europe contain only a single nest, four or more in one tree being exceptional.

III. Occupation, 1954-8

For the following account I am indebted to Col. P.H. Byers of the Railway Stores Department, whose work has involved constant visits to the Yard since 1951, and who is a keen bird observer. From 1951 - 54 he saw no herons here; then, suddenly, at the end of 1954, these appeared and at once began to nest, and although he made no periodical counts of nests he has a strong impression that from 1954 until 1958 the nesting was as continuous as it has been from 1958 onwards. (If there had been any obvious gaps when no herons were present, he feels sure that he would have noticed them, but he did not). As soon as the birds arrived he reported the fact to Mr. Lardner, the Stores Superintendent, who issued instructions



Map of the Heronry. Three breeding areas, "A", "B", and "C" are shown inside the dotted lines. "A" is the core of the colony and "B" and "C" are overflow areas. All trees likely to be used for nesting were marked with serial numbers, "A" with Nos. 1-66; "B" with 72-94 and "C" with 100-127. The numbers of some of the most regularly-used trees are shown. The site of the observation tower is indicated. Refer to Part II.

Breeding of the Black-headed Heron

TABLE 1. Monthly Counts of Nests.

1 Date Counted	2 Total Nests Counted	3 Number Seen Occupied	4 Estd Addtl Occpd Nests	5 Estd Total Occpd Nests	6 Estd State of Occupation		
					Buildg. %	Incubtg. %	Young. %
<u>1958</u>							
24/5	176	A	-	160B	-	40B	60B
19/7	121	A	-	100B	10B	-	90B
24/8	134	A	-	110B	10B	-	90B
7/10	157	A	-	120B	-	10B	90B
<u>1959</u>							
1/1	121	A	-	90B	-	-	100B
17/2	105	27C	13	40	10	-	90
17-8/3	96	17	3	20	-	-	100
23/4	75	51	9	60	10	80	10
29/5	76	61	4	65	-	10	90
26/6	64	28	2	30	-	-	100
16/7	61	13	2	15	-	-	100
31/8	44	3	1	4	-	-	100
14/10	40	4	-	4	100	-	-
14/11	27	19	1	20	90	10	-
19/12	47	38	7	45	10	80	10
<u>1960</u>							
26/1	32	28	2	30	10	-	90
20/2	25	21	-	21	-	-	100
31/3	78	74	-	74	90	10	-
26/4	179	169	-	169	-	100	-
28/5	119	A	-	85B	-	10B	90B
18/6	111	55	5	60	10	10	80
1/8	92	23C	7	30	10	10	80
13/9	48	27	3	30	80	10	10
13/10	39	28	5	33	10	80	10
8/11	43	31	4	35	-	70	30
3/12	42	30	3	33	10	30	60
<u>1961</u>							
7/1	30	15	-	15	-	10	90
2/2	29	21	2	23	50	-	50
9/3	23	17	2	19	60	10	30
2/4	32	30	-	30	90	10	-
3/5	54	46	4	50	10	80	10
3/6	45	29	6	35	-	50	50
2/7	38	31	2	33	10	10	80
30/7	34	24	1	25	30	10	60
2/9	26	4	1	5	50	-	50
30/9	33	29	1	30	90	10	-
28/10	93	83	2	85	70	30	-
2-3/12	192	104C	21	125	10	80	10
30-1/12	207	166	9	175	10	10	80
<u>1962</u>							
28-9/1	185	146	9	155	10	10	80
3-4/3	161	134	11	145	10	60	30
29-30/3	159	120	15	135	10	30	60
29-30/4	178	138	15	153	10	10	80
26/5	204	146	18	164	10	30	60
27/6	160	95	20	115	10	10	80
4/8	137	D	D	87	10	10	80
26/8	104	D	D	80	30	35	35
3/10	112	D	D	100	20	50	30



fig. 1



fig. 2



fig. 3



fig. 4

fig. 1. Black-headed Heron in hunched position.

fig. 2. The 80-foot observation tower showing floors of double-storey hide before the hessian walls were added.

fig. 3. Bird fluffing out plumage.

fig. 4. Same bird an instant later, with feathers smoothed down.



fig. 6



fig. 8



fig. 5



fig. 7

fig. 5. Aggressive pose towards diving kite (on left).
 fig. 6. Nests in Eucalyptus trees, seen from below.
 fig. 7. Bird calling before it alights.
 fig. 8. Bird at rest (right) inflates cheeks in display to landing bird (left).



fig. 9



fig. 10



fig. 11



fig. 12

fig. 9. Young bird doing downward-stretch exercise.
fig. 10. Nest and eggs.
fig. 11. Young doing wing-stretch with leg also extended.
fig. 12. Young doing flapping exercise.



fig. 13



fig. 14



fig. 15



fig. 16

fig. 13. Bird preens under-wing.

fig. 14. Bird doing stretch display. (Note colour of iris, which is red at this stage of breeding).

fig. 15. Bird with young looking at observer, using binocular vision.

fig. 16. Young (right) leaps to catch bill of adult (left) prior to being fed by regurgitation.

that the birds must not be molested. Very soon the colony became concentrated in area "A," which still constitutes its core. By the long rains of 1955, Col. Byers thinks that there were some 30 occupied nests. It seems clear, therefore, that colonization was made by a number of pairs within a short space of time. Sneyd Taylor: 203 mentions that a colony at Fort Beaufort, Cape Province, South Africa, was also established suddenly, eight nests being started within a month of the first arrival of the birds.

TABLE 1. Monthly Counts of Nests.

Abbreviations: A. No count made.
B. Guess made in default of count.
C. Numbers probably under-estimated.
D. Modified system of counting used.

This table should be read in conjunction with Part IV and the accompanying histogram.

Column

- (1) Date of count. All counts were made by me except the following: 23/4/59 and 26/4/60, by Mr. Leslie Brown and myself. In 1960, 29/5, 26/6, 16/7, 31/8, and 14/10, by Mr. Brown.
- (2) Total nests counted, whether occupied or not. All counts were made from the ground.
- (3) Total nests positively seen occupied.
- (4) An estimate of the nests believed occupied but omitted because there was no positive sign of occupation.
- (5) An estimate of the total occupied nests; the aggregate of the two previous columns.
- (6) An estimate of the percentage of birds building, incubating or with young. For instance, on 26/5/62 a small number were building, a fair number incubating and the majority were with young, and the result is construed as building, 10%, incubating, 30%, and with young, 60% - but such percentages must on no account be regarded as more than a rough, subjective estimate of the actual situation.

TABLE 2. Nairobi Rainfall.

MONTH	1958	1959	1960	1961	1962	Average (34 years to 1960)
	<u>Inches</u>					
January	3.13	0.77	3.80	0.07	8.63	1.71
February	8.92	0.58	0.43	0.65	0.19	1.82
March	2.21	6.06	9.04	2.28	1.35	4.36
April	2.58	3.98	5.47	4.52	6.41	7.82
May	18.78	5.07	3.00	5.07	7.88	5.52
June	2.00	0.06	0.51	0.47	4.46	1.69
July	2.66	0.50	0.20	0.36	0.01	0.59
August	0.00	0.55	0.40	0.28	1.04	0.77
September	0.24	2.84	0.65	1.74	0.61	1.08
October	0.41	0.14	2.65	5.09	-	2.00
November	1.00	10.02	3.65	21.67	-	4.67
December	3.92	1.41	2.17	9.33	-	2.74
Total	45.85	31.98	31.97	51.53	-	34.77

The figures were recorded at the Ministry of Works Hydrological Office, Nairobi, which is only a quarter of a mile from the heronry, so these rainfall totals may be taken as the totals for the heronry.

IV. Occupation, 1958-62

Since May 1958 a count of nests has been made regularly each month (or as near as practicable). The results are summarized in the accompanying Table 1. The nests were always counted by trees in accordance with the serial numbers mentioned in Part II. The total nests, whether occupied or not, are shown in column 2 of the Table. Such a count entailed no difficulties, but in addition, it was essential to estimate how many of these nests were occupied. Since they are in trees 60-70 ft. high and the counts had to be made from the ground, this was no easy problem, and nests in fact occupied were often no doubt recorded as unoccupied, in default of any positive sign of occupation. While the observation tower mentioned in Part V was in situ, the ground results were, of course, checked from here as far as possible, but the tower commanded only a limited number of nests and was available only for a limited period, so the bulk of the observations had, inevitably, to be made from the ground. However, a good deal can be ascertained with binoculars, and small signs, such as a protruding bill or tail, should be looked for. Visibility often depends upon the state of breeding when any given count is made; thus, a building bird standing on a nest will be very visible; an incubating bird sitting low in the nest may be invisible; eggs or small young are usually invisible, though the latter may be audible; large young are usually visible, and so on. The time of day for making a count is important, the best period being the evening, within an hour or so before sunset, since many birds will then be active and visible, awaiting their evening meal. Another excellent time to make a count is after a shower, when the birds stand up and dry themselves.

Three systems of estimating occupied nests have been successively tried, a major problem being the large number of nests and the consequent need for a reasonably fast method of counting. Under the first system, used from May 1958 until January 1959, I merely assumed, fairly correctly, that the bulk of the nests were occupied. However, this was far too vague, so the second system was adopted in February 1959 and continued until July 1962. Here, the nests were counted in each tree, and then an effort was made to see how many of these were occupied. The total nests seen occupied are shown in column 3 of the Table. However, a proportion must inevitably have been missed, so these were arbitrarily assessed for column 4; thus, an estimated total of occupied nests (columns 3 + 4) can be shown in column 5. This system worked pretty well but took a great deal of time, and even so, the number of occupied nests in any given tree had to be assessed with speed, so the figures obtained could not be more than approximate. From August 1962, therefore, a third system has been tried which takes half the time of the second and is, I think, little if any less accurate. First, a quick count of all nests is made for column 2, with no attempt to count the occupied nests. Instead, a few sample trees are selected as representative of the colony, and here a careful count is made of both the total nests and the number occupied, and the proportion of the one to the other is taken as the proportion for the colony. For instance, if the colony has 120 nests and the selected trees 20, of which 15, or 75%, are occupied, then the occupied nests for the colony are estimated as 75% of 120, or 90.

In addition, it is desirable to gauge the state of occupation for any given count, i.e. what proportion of the occupied nests are being built, or have eggs or young?. To this, some sort of answer is shown in column 6, in the form of percentages, but it must be emphasized that these are at best a rough estimate and often an informed guess. In fact, up to 1962 all data so provided should be regarded as mere informed guesses construed from field notes made at the time. From 1962 onwards, special attention has been paid to this point, and the soundest estimates have probably been formed under the third system, since, with only sample trees to study, one can now pay far more attention to the state of each individual nest than when attempts were made to cover all the occupied nests of the colony.

On the assumption that the estimated total of occupied nests shown in Table 1 is near actuality, the monthly nest totals have been plotted opposite the monthly rainfall totals on the accompanying histogram, since breeding is clearly linked with rainfall. The nest totals are calculated from Table 1 as for the last day of each month under reference, to reflect any reactions on the part of the herons to the presence or absence of rain during that month. The rainfall totals, recorded a quarter of a mile from the heronry, are shown in the accompanying Table 2. Brief comments on the successive years 1958 - 62 will now be made.

1958. (From May, when the counts began.) In May, there was an exceptional rainfall of 19 inches, but precipitation for the rest of the year was below average. The May total of nests was very high - 160 - and occupation remained high for the rest of the year at 90 or over. Nothing comparable to this re-occurred until 1961 - 62.

1959. Although the long rains were not much below average, occupation was poor and dropped sharply, until in August-September there

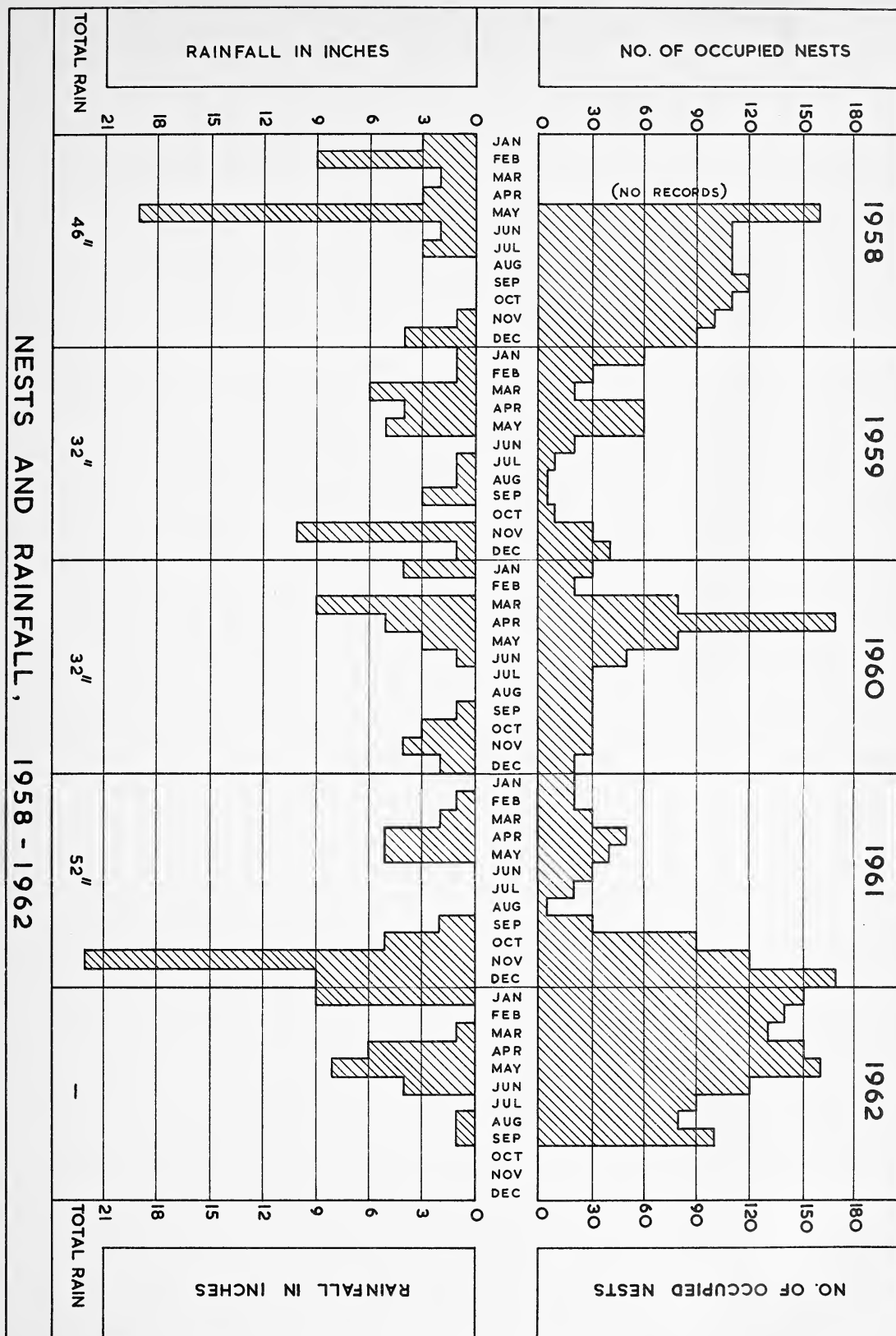
Histogram For Occupied Nests And Rainfall At The Nairobi Heronry.

This compares occupied nests (upper figure) with rainfall (lower figure). The nest-totals and rainfall-totals are from the accompanying tables in Part IV. Both are here approximated, usually to the nearest ten nests or to one inch of rain. The average annual rainfall is 35 inches and the average rainfall per month, in inches, as follows:

January	January	2	July	1
	February	2	August	1
	March	4	September	1
	April	8	October	2
	May	6	November	5
	June	2	December	3

Note how the exceptional rain of May 1958 appears to have triggered-off a prolonged period of breeding at high level, and the same applies even more strikingly to the rain of November 1961. During these high-level breeding periods one can only speculate about the identity of the birds concerned : can certain pairs have bred two, three or even four times running? Or did these breed once and were replaced by other pairs ? Perhaps the truth may lie somewhere between these two ideas.

When the rains were poor, as in April-May 1959 and 1961, occupation was low and dwindled until in August there were only five nests - the nearest approach to lulls in breeding yet recorded. Nevertheless, breeding has in fact been continuous over the whole period of observation, now 4½ years. The study continues.



were only 4 nests, which is the nearest approach to a pause in breeding yet noted, and even an exceptional rainfall of 10 inches in November resulted in only a small increase in nests, contrary to expectation. Perhaps 1959 may have been a resting-period after the big occupation of 1958 ?.

1960. The long rains began in a very promising way, with the March rainfall, at 9 inches, double the average; then, during April and May, precipitation fell off, though not abnormally, and the short rains were average. From this, one would not have anticipated the remarkable nesting curve shown on the histogram, with a record total of 170 nests in April, followed by a rapid collapse. Apparently many birds were encouraged to breed by the excellent start of the rains, then lost interest when this early promise was not fulfilled. However, although 90 out of 170 pairs abandoned the attempt to breed, the remaining 80 persevered, and indeed there was a fair core of breeders, about 30, for the rest of the year. Possibly the 90 failures included birds reared in 1958 now breeding for the first time, perhaps not seriously ?

1961. Rainfall in both 1959 and 1960 had been below average and continued poor in 1961 till September - in fact, this period in many parts of Kenya was regarded as one of the worst droughts in memory. It is thus astonishing that the herons continued to breed in fair numbers throughout the whole period. The nesting curve for the long rains of 1961 is just what one might expect under the circumstances - a small maximum followed by a steady decrease, with a very low total of 5 nests in August. Then, the short rains turned out to be phenomenal, with the huge precipitation of 22 inches in November alone, and from October occupation soared to a record total of 170 nests at the end of December. Such a rise might well have been predicted, as there had been no large occupation since 1958.

1962. (To date of going to press in October.) Although the long rains were no more than average, breeding ever since the beginning of the year has remained at an unparalleled level, 1958 being the only other comparable season. In fact, for the 12-month period from October 1961 till September 1962, the average occupation has been 125 nests, with a maximum of 170 in November and a minimum of 80 in August. Let it be assumed that there will now be at least one more month of breeding at a comparable level, as is most likely. This would bring the period up to 13 months, or about 400 days. In part IX it will be mentioned that the breeding period of this species appears to be about 100 days; therefore, 400 days are equivalent to four successive breeding periods. Very likely a statistical analysis would throw light on these problems, but meanwhile, two extreme hypotheses, each unlikely, can be postulated : first, that during the 400-day period, 125 pairs could each have had four broods in succession; or secondly, that during this period, 600 pairs (125×4) could each have had one brood. Perhaps the truth may lie somewhere between these two assertions, bearing in mind that 400 days could cover either four successful breeding periods or a series of unsuccessful attempts of irregular duration, or any combination of the two. In default of large-scale colour-ringing there is no positive evidence of successive broods; nevertheless, the probability that many pairs may have had at least two broods during the period under discussion is surely very strong. A similar probability occurred to Pitman:32 with regard to the Entebbe heronry. He writes : "I have little hesitation in saying that the Black-headed Heron is double brooded, and it is possible

that more than two broods may be reared in one year". But to return to the Nairobi colony, as an alternative to successive broods one may well assume that since October 1961 a number of pairs have bred and left, and have been succeeded by others. The latter could be locally-reared young birds now breeding for the first time, or local adults returning to breed, or immigrants arriving from elsewhere (attracted, maybe, by the success of the colony). In general, it seems that the exceptional rains of both May 1958 and November 1961 resulted in a period of high-level occupation which persisted for many months subsequently, even though the rainfall during most of these months was nothing out-of-the-way. However, the effect of the 1961 short rains is still evident : many temporary pools have persisted and the streams remain unusually high; also, the seasonal vegetation has remained exceptionally green - all of which may well have created unusually favourable conditions for the creatures mentioned in Part VI which constitute the herons' prey.

P.S. The nest-count for the 21st. of October was as follows: total nests, 139; number estimated occupied, 110 - building, 50%; incubating 25%, with young, 25%. Rainfall, 1st. to 21st. October, 2 inches.

If reference is made to the map in Part II it will be noted that there are three breeding areas, "A", "B" and "C". Of these, "A" is the core which is always occupied and "B" and "C" are outlying areas used during big occupations. The history of these outliers is a useful indication of the success, or otherwise, of the colony. In fact, they have been used only three times during the period of study, the first two occasions being failures and the last, a spectacular success. During the long rains of 1958 and also of 1960 about 20% of the nests were in the outlying areas at the peak of the breeding season, but nearly all of them were abandoned within a month of occupation. During the short rains of 1961, however, both these areas were occupied at a far higher level than previously, and occupation has since been continuous to date. They have contained up to 40% of the nests of the colony. Lowe: 83, discussing A. cinerea, thinks that outlying nests may be the product of birds breeding for the first time. This might well apply to the Nairobi colony, but might not adult immigrants also tend to use these outlying areas ?

There is no evidence that non-breeding herons come to the colony at night to roost, and therefore no likelihood that such birds could be confused with the breeders. Herons seen at the colony appear to be exclusively : (1) birds which want to breed - usually with the red eye; (2) birds actually breeding, and (3) young which are still being fed at the nest.

The breeding fluctuations of the Nairobi colony over the years of study may be briefly summarized, as follows: (1) Exceptional rains in May 1958 and November 1961 resulted in many months of high-level occupation (and note that one case concerns the long rains, and the other, the short, which indicates flexibility on the part of the birds); (2) when the long rains were moderate or poor, as in 1959 and 1961, occupation was poor and then dwindled; (3) the failure of the birds to respond to the good rains of November 1959 and the breeding fiasco of April 1960 are difficult to understand; (4) the nearest approach to a cessation in breeding occurred during the dry weather of August 1959 and 1961 after poor long rains; (5) nevertheless, breeding was continuous over the four years.

This 4-year period of continuous breeding is particularly unexpected in a locality such as Nairobi, with its two pronounced dry periods - June to October and January to March - during which one might well have thought that the commencement of breeding would be highly improbable. On the other hand, continuous breeding could well be anticipated in the humid parts of Uganda or West Africa, and evidence of this is accumulating. In West Africa, Guichard, 1947 : 461 was shown an A. melanocephala colony in Nigeria and the local inhabitants told him that the birds occupied the tree throughout the year. In Uganda, Miss Allen has recently been studying a colony in a tree at Makerere College, Kampala, and has now, by periodical counts, proved one year's continuous occupation, which is all the more remarkable as this colony is small and never, during the year, much exceeded 20 nests. Captain Pitman knew this colony from 1925 and Mr. Basil Sebley, who lived at Kampala from 1939 - 61, frequently visited it and can never remember failing to see at least some birds present. From this, one may suspect almost continuous occupation over the last 20 years at least.

Perhaps, therefore, continuous or near-continuous breeding on the part of A. melanocephala may prove to be more of a normal practice than has been suspected hitherto; nevertheless, the picture should not be over-drawn and seasonal breeding is clearly widespread and may well be the more normal, judging by the periods mentioned in Praed and Grant, 1952 : 40 for many parts of Africa, all of which are seasonal, though in some cases these are prolonged.

To date, I have been able to discover only a few records for continuous breeding comparable to A. melanocephala, but Stonehouse et al. 1962, have some interesting examples, especially for Tropic Birds, Phaeton spp., on Ascension Island, while for land birds there is a remarkable record for Scotland by Lees, 1946 : 136, who studied the breeding of Rock-Doves, Columba livia Gmelin, in the coastal caves of Cromarty over a period of nearly two years. Of the four caves so studied, each contained a small colony of these doves and breeding continued more or less throughout the two years, with a maximum in April and a minimum in July, and in each cave there were alternate periods of nesting and quiescence, the latter usually short. Presumably the all-weather shelter which the caves provided, combined with an all-year-round food supply, rendered this feat possible.

V. The Observation Tower, 1960 - 61

To study the herons at nest-level, a hide was required. In default of a tree suitable for the purpose, the only alternative was a tower which, however, needed to be very high - 80 ft. - to command the nests, so its construction was a professional undertaking. A reconnaissance of suitable nests having first been made with the assistance of a Nairobi City Council Fire Escape, the Railway engineers then constructed a fine temporary tower of tubular scaffolding (Pl. 1, Fig. 2). The base was 14 ft. square, tapering to 7 ft. at the top, stability being assisted by cross-bracing and external props. The tower was surmounted by a double-storey hide with the lower compartment enclosed in hessian; but the upper, at the 80 ft. level, had an open balcony with unobstructed views in all

directions. A vertical ladder afforded access to the hide from the ground. A pulley and rope were used for securing inexperienced climbers or for hauling up equipment. Equipment was tied to the two ends of the pulley-rope which were knotted together to form a loop which passed through a shackle secured to the ground ten yards from the base of the tower. This kept the equipment well away from the tower and prevented it from striking against the structure.

In practice, the balcony was used much more than the hide because the views were so extensive and the behaviour of the birds differed very little no matter whether the observer was on the balcony or in the hide. The more regularly the observer was present, the tamer the birds became. Their young ignored him completely and so would the parents unless the nest was very close to the tower, but incubating birds could be shy and might perch on a neighbouring tree and wait; if so, it was necessary to descend to the ground when they would return at once. It was rare for any action or noise on the part of a person on the balcony to alarm birds enough to cause them to take flight; in fact, they seemed more disturbed by the pulley-rope when it flapped about, perhaps because it resembled a snake. By far the best observations and photographs were made from the tower immediately after its erection, when some 50 existing nests could be studied, many within a distance of 30 to 60 feet. However, birds which began to nest after the erection of the tower tended to build somewhat further away and to seek a little concealment by intervening leaves. The Railway authorities kindly left the tower up for 15 months, eventually dismantling it at the end of August 1961. Full advantage was taken of the opportunities for study thus provided.

VI. Food, Foraging and Roosts

During 1961, some 52 casts were collected at intervals from beneath the trees of the heronry and analysed by Mr. J.G. Williams, Ornithologist, and Mr. J.D.L. Fleetwood, Mammalogist, of the Coryndon Museum, Nairobi. The results provide an interesting picture of the varied diet of this species, though not, of course, a complete picture, since certain forms of prey like frogs or fish may be totally digested and will thus leave no trace in the casts. As a characteristic sample, here are details of ten casts collected on the 16th. April, 1961:

1. Skull of domestic duck; fur and teeth of rodent Otomys.
2. Rodent hair, fish scales, heron feathers.
3. Coarse white hair, probably goat.
4. Mass of large grasshopper and some beetle fragments.
5. Fur and bones of rodent Otomys; fish scales.
6. Rodent fur and bones, grasshopper fragments, fish scales.
7. Mass of grasshopper fragments.
8. Mass of feathers - most, perhaps all, from neck of domestic fowl.
9. Rodent fur and bones; fragments of bark.
10. Fur and bones of Otomys, water beetle fragments, fish scales; unidentified avian bone fragments.

Of the 52 casts analysed, 34 contain traces of rodents, 23 of grasshoppers, 19 of fish, 16 of beetles, 10 of birds, 5 of vegetable matter, 4 of mammals other than rodents, 2 of frogs and 1 of a crab.

Eleven of the casts consist of rodent remains only, but the rest have more than one ingredient and some as many as four. The rodent remains are almost certainly those of the Swamp-Rat Otomys angonien-sis Osgood, a nocturnal rat living in long grass. Though insect remains are fairly plentiful, Mr. Williams believes that many are digested and leave no trace, e.g. the Mole Cricket Gryllotalpa, which he knows from stomach contents to be a common prey. The same applies to fish; in fact, it is lucky that the one identified, a Barbus, leaves indigestible scales. The bird and mammal remains contain some surprising items including a domestic duck's skull, a Lesser Flamingo's skull, heron's feathers, fowl's feathers, also hair from a Marsh Mongoose Atilax paludinosus (Cuvier) and from a goat - which may indicate that this bird is something of a scavenger in addition to capturing live prey. The vegetable matter includes bark and fibre (and in addition, Mr. A.D. Forbes Watson once found a cast with several undigested maize seeds in it). The scarcity of frog remains is no doubt because these are digested; in fact, Mr. Williams believes that rodents and frogs constitute the main diet of this species.

Lowe : 51 -3 stresses the fact that British frogs and fish are totally digested by A. cinerea and do not show in casts, thus, to ascertain what the bird eats, the cast-analyses must be supplemented by stomach contents and by watching what the birds catch. He says that too much vegetable matter is found in A. cinerea stomachs to be likely to be accidental and wonders if this is consumed for roughage. Pitman : 34 considered that A. melanocephala at Entebbe subsisted mainly upon rats, frogs, mice, lizards, beetles and other insects, with an occasional snake. Sneyd Taylor : 208, summarizing the analysis of some 200 casts at Fort Beaufort, found the diet very varied, insects, especially grasshoppers, Mole Rats Cryptomys and House Lizards Mabuya being prominent. As a result of his investigation he concluded that A. melanocephala was agriculturally beneficial. The same may well apply to our East African birds.

This species can operate two kinds of vision : monocular, with each eye covering a separate arc, or binocular, with both eyes converging forwards (Pl. 4, Fig. 15). This latter type of vision must be particularly advantageous when the bird is hunting prey near at hand on the ground or in water. It has not yet been possible to make any detailed study of its hunting methods, which will no doubt vary considerably in relation to the type of prey sought. However, one morning recently an instructive 1½ hours was spent watching a bird catching mice in the Nairobi National Park, the locality being an open ridge with short grass and patches of sedge near Lone Tree. The bird, which was an adult, was so accustomed to cars that it permitted a Jeep to accompany it at a distance of 30 - 60 ft. during the whole of this period while it carried on with its hunting (which was photographed). Most of the time the bird strode across the grass using a formal, peculiar and comic gait, raising the feet high, perhaps to avoid making a noise. For a step or two the neck would be at full stretch and angled slightly forward, with the head and bill horizontal; then, for the next step or two, the head and neck would be bent sharply backward in the form of an S, which, with the slow, ponderous strides, resulted in a goose-step effect. The two poses would be adopted again and again as the bird walked over the grass and were, presumably, in some way linked with the hunting. It was the patches of sedge which interested the bird most. Here it would stop, with the head in the high forward position, and might

then perform a remarkable series of sideways undulations of the neck, at about two per second, with body and head remaining still. Immediately after a series of such undulations the bird struck downwards with its bill, catching a small mouse between the mandibles which it immediately swallowed. A second mouse was caught similarly, but without the undulations. These two mice were the only prey captured during the 1½ hours of observation.

Jackson : I. 34 has an excellent account of the hunting of this bird in a sweet-potato plot; the bird moved "very quietly and cautiously, drawing up each foot slowly and extending it at each step with the utmost deliberation, with neck stiff and held well forward. On detecting its prey, rat, lizard or insect, it occasionally snapped it up at once; but more often it began to sway its neck sideways, slowly at first, but getting faster and faster until the body also began to sway. While this movement was going on, its head and neck were being gently lowered until within exact striking distance, when both were suddenly shot forward. In this manner it caught several small rats, striped mice and lizards." Jackson's bird thus seems to have acted very much like the Nairobi individual did, though he does not mention any goose-step. He comments : "It has always been a puzzle to me why this bird and the Buff-back wriggle their necks in the way they do. In the case of rats and mice, and perhaps lizards, it certainly may have a mesmeric effect, but it is incomprehensible in the case of locusts, grasshoppers and such-like."

At the Nairobi heronry the young are fed by day, at any time, though the main feed is in the evening, before dusk. Col. Byers and the Watchmen agree that there is little, if any, feeding of the young by night; if there was, it would surely be obvious on account of the loud "kek-kek" hunger calls which the young make when about to be fed. However, the birds may well hunt by night as they can often be seen leaving the heronry at dusk; and how otherwise could they catch a nocturnal rat like Otomys ? Praed and Grant, 1952 : I. 39 say that this species feeds mainly by night and it seems that the night-feeding of the young is normal in Uganda (Jackson : 35, Pitman : 27) and at Fort Beaufort, S.A. (Sneyd-Taylor : 205).

With regard to the hunting grounds and the flight-lines between these and Nairobi, only a limited study has been practicable to date, though it is hoped that more will be possible later. At Nairobi, inward and outward flights have been watched both from the heron-tower and from the roof of the Ministry of Works. It is not easy to assess direction from inward flights, as the birds become visible only when relatively near, but outward flights can be observed for a considerable distance : a departing bird was once kept in view for 4 minutes, during which it may have travelled some 2 miles, assuming a speed of 30 m.p.h. Mr. J.B. Smart was once able to follow a flying bird by car along a road for about 4 miles, and it maintained a speed of 30 - 35 m.p.h. which can be taken as the air-speed, there being little or no wind that day. Lowe : 113 gives 30 m.p.h. as the normal speed for A. cinerea.

The speed of wing-flap for this species, taken from a number of stop-watch timings of birds in horizontal flight, is regularly 170-180 per minute. Lowe : 113 gives the comparable speed for A. cinerea as 120 - 130 flaps per minute, which is considerably slower; indeed, this difference in flap-rate should be a good distinguishing feature between the two species. Of course, A. melanocephala, with a wing of

about 400 mm., is smaller than A. cinerea, with about 460 mm. (figures approximated from Praed and Grant, 1952 : 38 - 9).

Though birds have been seen departing from the heronry in all directions, the most favoured line is certainly between west and north-west, in the direction of the Kikuyu country which rises towards Limuru, with its swamps, streams and cultivated lands. Mr. H.J. Lee, when living at Dagoretti Corner, five miles west of the heronry, constantly noted birds passing over and there are many other records from the Kabete region, 7 - 8 miles north-west. The most distant feeding ground from the Nairobi heronry yet discovered has been located by Mr. Smart at Nyakumu Swamp, 3 miles west of Kikuyu Railway Station and 15 miles from Nairobi. Witherby, 1938 : III. 126, states that the regular feeding range of A. cinerea is up to 12 miles.

To date, no evidence has come to light that non-breeding birds use the Nairobi breeding colony (or other such colonies) for roosting, and evidence is only now beginning to accumulate to show where such birds do roost. Mr. Smart has recently located and shown me a substantial roost of about 60 birds in a fig-tree beside the Nyakumu Swamp, most of them in juvenile plumage. They arrived from all directions and were very noisy, barking and growling just like the adults do. A few birds have also been noted roosting with other species in a tree beside a dam at Karen, about 8 miles from Nairobi.

VII. Relationship with other Birds

The gum trees of the Stores Yard, besides accomodating the heronry, are also used for roosting by numbers of Kites Milvus migrans (Bodd.) and Pied Crows Corvus albus Muller all the year round, though neither species breeds here. According to Col. Byers this roost anteceded the heronry. The kites roost anywhere in the gums, including those of the herons, but usually at a lower level, beneath the canopy. The crows mostly roost clear of the heronry at the south edge of area "B". However, both species, when they first come in, may perch anywhere, often right among the herons, and the latter only show antagonism if one of these passes or perches very close, in which case the heron's reaction is a hostile posture often accompanied by a squawk or peck (Pl. 2, Fig. 5) - which is merely how it would react to another heron under similar circumstances. Relations are thus amicable, and I have not yet seen a kite or crow attempt to molest the eggs or young of the herons. Few small birds are seen around the colony, but when a heron is preening, a small piece of fluff often floats away from the tip of its bill and may be seized by a Little Swift Apus affinis (Gray) for nesting material.

It seems that the Nairobi colony has only one serious bird enemy - the African Hawk-Eagle, Hieraaetus spilogaster (Bonaparte), which seems to be a habitual predator upon the young of this heron. In 1958 an eagle in puzzling immature plumage, eventually identified as H. spilogaster by Mr. D.K. Bednall, was often seen at the heronry, the normal sequence being : (1) Eagle flies to colony. (2) As soon as it is visible, all herons capable of flight take wing, shrieking. (3) Eagle alights on chosen nest, unmolested by the herons, and feeds on the young. (4) Meanwhile herons alight on adjoining nests

and carry on normally. (5) When eagle takes flight to depart, the herons take wing, shrieking as before, but soon return. This sequence was filmed by Mr. S.J.K. Collins and a sound-recording was made by me. It would seem that an eagle in flight is the chief cause of terror to the herons, though they do not normally molest it when perched, either. This bird often used a tree a little way from the heronry to rest, with bulging crop, after a meal, and one evening a couple of Pied Crows turned up prior to roosting, saw the eagle and kept diving at it with loud caws until it flapped off. Thus, mere roosting crows could eject the eagle, which apparently the nesting herons dared not do. It was feared that this eagle would disrupt the colony if left unmolested, so Col. Byers shot it at our request. He says that two other eagles of the same species have preyed upon the colony since then. The first, which was shot in November 1960, proved to be an adult female. When this was perched on a nest he saw a heron actually diving at it. A third eagle arrived in 1962 but left at once.

It appears that the young of A. melanocephala may be a normal prey of this eagle, judging not only by the examples just mentioned, but from Jackson : 181, where at Kampala one of these birds "for many consecutive days visited and raided, twice daily, a large breeding colony of A. melanocephala that nested in a single very tall tree in the market place. Directly the eagle appeared, every heron able to fly left the tree and circled round uttering their harsh croaking squawk; but in spite of their numbers they had not the courage to attack the intruder and drive it away. The eagle then took up its position on a bough, and after calmly surveying its surroundings for some little time, would half jump, half fly on to a nest containing young birds, pick one up, hop back on to a bough and devour the hapless youngster. The operation was repeated two or three times; it then rested for a short period and finally took its departure." The bird was collected, and proved to be a fine male, and "when shot, its stomach and crop contained three young herons the size of doves, and in each case the head had been torn off and bolted whole."

There is a case on record (Pitman, 1942 : 254 and personal communication) where a couple of Fish Eagles, Cuncuma vocifer (Daudin) are strongly suspected of the wanton destruction of a whole Black-headed Heron colony with some 50 nests which were in low vegetation on an islet of Lake Mutanda, S.W. Kigezi, Uganda. One day Pitman noted a tremendous commotion in the heronry and saw the eagles amongst the agitated herons, after which most of the latter disappeared. Next day he found that 47 nests with eggs had been destroyed, presumably by the eagles. Mr. Brown informs me that he has noted Cunouma systematically preying upon the young of this heron in similar style to that of H. spilogaster.

If H. spilogaster preys on young herons, at least it appears only to molest the birds which it eats, though it might, in time, destroy all the young of a small colony. It seems that A. melanocephala is partial to nesting near the haunts of man and it might be wondered if this has any effect of discouraging the attacks of large birds of prey such as H. spilogaster? Any such effect, being negative, would be difficult to prove and the positive evidence from H. spilogaster - a very bold bird - indicates that in Nairobi and Kampala the presence of man in no way discourages the

eagle from attacking the herons.

VIII. Breeding - Early Phases

The early phases of breeding are complex, and I cannot yet claim to have more than a general idea of what goes on. For this, Meyerriecks' account of his four North American species, with Mrs. Buffler's admirable illustrations, has been invaluable.

The sexes of A. melanocephala are indistinguishable in the field, which is a handicap to study : the same applies to A. cinerea and herodias, it seems. However Meyerriecks : 72, who made a 3,000-hour field study of Butorides virescens (Linn.) gives a useful table of the field-distinctions between the sexes of this species, some of which might well apply to the other herons. In the normal adult plumage A. melanocephala has the chin white, a speckled band down the front of the dark throat and the under-parts grey. However, fully melanistic birds can very occasionally be seen with the chin and entire underparts black, and it is not unusual to see birds where the throat is plain rufous and not speckled. It is remarkable how instantaneously a bird can alter the set of its plumage, e.g. compare Pl. 1, Fig. 3 with Fig. 4, taken within a second or two of each other. In Fig. 3 the bird was shaking out its plumage; it retracted the neck, erected the plumes of the crown, chest and back and relaxed the wing-feathers. Then, in Fig. 4, it extended the neck and smoothed down the feathers which transformed its appearance in a flash. (In general, raised plumes with shortened neck usually imply aggression, and smoothed plumes with elongated neck, fear). The preening of this species seems to be identical with that of A. cinerea, so thoroughly described and illustrated especially by Percy, 1951, and I have only one feature to add : the spectacular habit of preening the under-wing (Pl. 4, Fig. 13). The bird stands on a perch in the normal way, stretches out one wing horizontally, lowers the neck, twists the head upwards to inspect the outstretched under-wing and pokes about with the bill.

The iris of the normal adult bird (and of the young) is yellow, but when birds arrive at the colony with the presumed intention of breeding, the iris in both sexes is ruby-red and remains thus throughout the period of claiming the nest-site and building the nest, but by the time that the eggs are laid the iris will have reverted to yellow through an intermediate orange phase. Odd to relate, no evidence has been found that this colour-change has been published before, though it regularly occurs at Nairobi and elsewhere and is undoubtedly a normal feature of the species. So far as can be ascertained, the iris of no other heron has been observed to change colour in a comparable way, though a similar but much less-pronounced tendency has been noted for A. cinerea (Lowe : 73). However with both A. cinerea and many other herons the bill and feet may change colour in the breeding season, whereas with A. melanocephala it is believed that they do not.

With many herons it appears normal for the male to take up a prominent position on a branch in the place where he intends to nest, and here to advertise his presence in various ways in order to attract a mate; in fact, with A. cinerea, Lowe : 76 points out that it is the female who selects her male as she can move round and make

her choice, whereas he remains static. Very likely A. melanocephala behaves similarly, though it has not yet been possible to make a close study of this. One often sees a red-eyed bird in beautiful plumage, standing passively and silently on a branch or nest, with the head sunk between the shoulders in a vulture-like pose. I call this the hunched position (see Pl. 1, Fig. 1, though the iris of this particular bird was yellow). The bird is not usually aggressive and makes no attempt to build, so it is uncertain how serious the breeding urge may be, though surely there must be some urge or the bird would not be hanging round the colony or have a red eye? Lowe: 83 mentions mate-less A. cinerea with strong sexual desires which are found in colonies and often constitute a nuisance to the nesting birds; perhaps the same may apply to A. melanocephala? More than once the iris of an inactive red-eyed bird has been observed to fade from red to orange, which was taken as a sign of the diminution of the breeding urge.

On the other hand, a red-eyed bird positively staking a claim to a nest-site is both active and aggressive. The chief actions and calls centre round what Meyerriecks : 43 calls the stretch display (Pl. 4, Fig. 14). A typical display, done alone by a presumed male perched on a branch, is as follows: The bird, usually starting from the hunched position, straightens the legs, elevates the body till it is steeply canted upwards, elongates the neck and raises the head till the bill is almost vertical. The three long occipital plumes may or may not be raised; the plumes of the lower throat and breast are normally raised, but those of the back remain down. At the top of the stretch the bird makes a soft deep little noise, slurred-down in pitch, resembling a dove's coo or the whine of a dog, "how-oo", often accompanied by a puffing-out of the cheeks or throat; then, keeping the bill pointed upwards as before, the bird slowly sinks by bending the legs and lowering the neck backwards, and while doing this it usually makes a gentle gurgle, "roo-roo-roo-roo". Finally, it resumes the hunched position. Displays vary, however; for instance, during the descent the neck may at times be swayed from side to side, and the stretches can either be silent or accompanied by the coo and gurgle. An intense bird may stretch every few moments. If another individual approaches, the reaction of the perched bird will be hostile and may include a remarkable threat display in which it raises the three long occipital plumes, one vertically, one horizontally to the right and one horizontally to the left, the action often being accompanied by a peck and by the threat-note, a harsh, screeched "keh". Lowe : 76 points out that with A. cinerea a male holding a nest-site will at first be equally hostile both to other males and to other females; in short, it takes him a little time to recognize a female as such and to accept her. Another typical action of the perched male at this stage is slowly reaching out the neck towards a nearby twig, which may be grasped between the mandibles, but not broken off - presumably the first stage towards nest-building. It would seem that the stretches of A. cinerea, herodias and melanocephala are very similar, judging by Lowe, Percy, Witherby, Meyerriecks and Cottrille. All three species belong to the large type of heron which functions in a stately manner; with the smaller species such actions may be accelerated considerably - for instance, Meyerriecks : 136 actually describes and illustrates an aerial stretch display for the American Snowy Egret Leucophorax thula (Gmelin) and thinks (personal communication) that one or two of our little African species may well do something similar : if so, it would be worth watching.

After a single bird has occupied a perch and displayed alone for a time, one next sees two birds together, bending earnestly over the slender twig-foundation of a nest : the male, it appears, has secured his mate, and building has begun. After this, I assume (following A. cinerea analogies) that the male will take over the duty of bringing materials, and that the female stays on the nest and builds. One often sees a red-eyed bird doing a solitary stretch on a nest, and this could either be a male occupying a nest at the pre-mate stage, or a female stretching while the male is away collecting materials. Many nests of the heronry, especially in area "A", seem to be constantly used; as soon as the young of one family are fledged the nest may soon be re-occupied, by the original pair for a second brood, perhaps, or else by another pair.

If a pair take over a ready-made nest, there may be no need for them to do any more building, though in fact they often do plenty until it becomes huge, like some of those shown in Pl. 2, Fig. 6. It is believed that the Nairobi birds use materials from gum-trees exclusively, with bare twigs for the structure and leafy ones for the lining. All materials are carried in the bill, not with the feet. At Entebbe, Pitman : 26, 31 describes varied linings of rags, grass, hair, etc., and says that these linings are usually held in the feet, though sticks are carried in the bill. At Nairobi, individuals differ in their methods of collecting materials : some break twigs off the nesting tree; others bring them from a distance and yet others take them from unoccupied nests near by. Only very rarely do birds take twigs dropped from the nesting tree.

A bird about to arrive at a nest makes a series of loud barks which are usually known as the greeting call, though I prefer "alighting call" as I do not believe that it is invariably made as a greeting. My impression is that this call is most intense and prolonged during the nest-relief ceremony done by incubating birds, and less so for building birds or those about to feed young. A building bird bringing material will bark "kow-owk, kow-owk, kowk" without opening the bill much (or it would drop the twig) so the effect is somewhat muffled. The bird (presumed male) then presents the twig to its mate with crest raised, and the mate, before taking the twig, often makes a brief silent stretch display to the male. (Quite possibly, females do not coo.) The male has not been observed to do a stretch in return. The female then places the twig in position with the male looking on and sometimes assisting. No bill-snapping display has yet been noted as for A. cinerea, (see Witherby 1938 : III. 128.) and herodias (Meyerriecks : 98).

Coition on the nest has been seen on several occasions : the female lies passively in an incubating position, with her chin resting on the brim. The male then mounts her, resting his tarsus on her back with his toes well forward near her nape, and often wing-flapping to keep his balance. One male after coition stood on the female's back for a couple of minutes while she raised her head and looked round.

After the eggs have been laid, the birds relieve each other from time to time, when, judging by the calls, emotion is at a high level. The returning bird (Pl. 2, Fig. 7) first makes the normal alighting barks, but these are then followed by prolonged growls "kwo-o-oh, kwo-o-oh" and short conversational calls "kut-kut-kut"

to which the bird being relieved may answer similarly. In one case a relieved bird made an alighting-type growl before taking off. The normal clutch is 3, sometimes 2. The eggs are pale blue and resemble those of A. cinerea. One is figured in colour by Priest, 1948, Plate 1. My Pl. 3, Fig. 10 shows a nest with eggs. Unfortunately I have not yet succeeded in recording an incubation period, on account of a series of mishaps, but Priest, 1948, 3 gives this as 23 - 27 days and Lowe : 81 considers the average for cinerea 25 days; therefore, when estimating A. melanocephala's total breeding period in Part IX I have assumed the incubating period to be about 25 days.

Within the colony, there is a good deal of quarrelling, mostly trivial, between nesting birds and their neighbours or with intruding birds. In threat, the long plumes of the crown and chest, and particularly the short feathers of the throat, are raised and often accompanied by the threat call "keh" and a peck, corresponding to Meyerriecks' "forward display"; I have not yet noticed the "aggressive upright display" of both A. cinerea (Lowe : 19) and herodias (Meyerriecks : 96) where the bird takes up a hostile pose with neck arched and crest raised. A. melanocephala does, however, adopt a distinct posture of aggression-cum-fear if it is perched on a branch and another bird (crow, kite or heron) dives close past (Pl. 2, Fig. 5). Here, the wings are extended with the neck held stiffly upwards and the throat feathers raised to an extreme; the head is kept horizontal, at right-angles to the neck; the crest feathers and occipital plumes may also be raised, and the display is often accompanied by the threat-call. I have not read of anything similar for A. cinerea or herodias, but this seems to correspond to the "stiff-necked upright display" for B. virescens as described by Meyerriecks : 30, which also seems to combine the conflicting tendencies of aggression and fear. A mildly anxious bird, usually with extended neck and slimmed plumage (Pl. 1, Fig. 4), makes a series of soft, deep calls "kah, kah, kah, kah" often kept up for some time; this was characteristic of birds which did not dare visit their nests while an observer was in the tower. The call of extreme alarm, as used for a Hawk-Eagle, is a prolonged screech, "kaah".

IX. Breeding : The Young Birds

For this part, Lowe's Chapter 7 has been invaluable. In Part VIII it was mentioned that the normal clutch for A. melanocephala is three eggs; from these, three young are normally hatched, but only two are fledged. Occasionally all three young may be fledged, but this is exceptional. Quite a number of small young seem to get killed by falling out of the nests; for instance, on 31.12.61 when there were 175 occupied nests, 25 dead chicks were counted beneath the trees. Sneyd Taylor : 206 has a similar observation.

The breeding cycle of this species can be divided into three parts - nest-building, incubation and fledging of the young. As a working hypothesis I have assumed that the breeding period may be about 100 days : 15 for building, 25 for incubation (see Part VIII) and 60 for fledging, the latter being in accordance with the figure given for A. cinerea by Lowe : 95. But the building figure, in particular, is certainly most variable, since it includes not only active building, but alternatively the period of adoption of an already-built nest. "Breeding cycle" as defined in Part I starts with

courtship, which postulates a mated pair. With A. melanocephala, the activities of such a pair commence when they start to build a new nest or occupy an existing one. A bird seen standing on an already-built nest is here assumed to be mated and thus within the breeding cycle as defined, but a solitary red-eyed bird occupying a branch with, as yet, no signs of a nest is assumed to be un-mated and thus still outside the cycle. Such assumptions are arbitrary and may not always be correct, but they provide a clear working rule and thus enable observations to be consistent.

Three nesting records will now be mentioned. These are incomplete, since my visits to the heronry, though as frequent as possible, were irregular. Most of the data were obtained while the tower was up.

The first record relates to nest 1 of tree 34 in 1960. 14/7/60, birds actively building. 19/7, no eggs but bird in incubating position. 24/7, coition took place. 21/8, three small chicks. 2/9, still three. 11/9, probably two. 2/10, two large young. 9/10, two still present, after which observations ceased until 7/11 when the nest was found to be re-occupied and with 3 eggs. This example might fit the assumed 100-day breeding period fairly well, if building began about 7/7, incubation on 24/7 and fledging from 18/8 to 18/10.

The second record refers to the "great nest" of tree 24 in 1961. 20/1/61, a yellow-eyed bird standing on the nest. 11/2, nest repaired but no birds about. 9/3, bird incubating. 10/4, three smallish chicks. 3/5, still three, now big. 7/5, at least one of these can now fly. 3/6, two big young still in nest; this may well be an example of a pair rearing all three. 2/7, nest empty, but it was re-occupied, I think, early in September. In this case it looks as if the "building" period - really, the occupation of this existing nest - was much prolonged, between 20/1 and 9/3, and it is odd that the bird of 20/1 had a yellow (not red) eye.

The third and last record is of some interest, as it appears to involve a change from parents to "guardians". It concerns nest 1 of tree 47 in 1960. 20/6/60, a pair of normal-throated birds building. 2/7, birds standing about, not building. 8/7, bird incubating. 31/7, bird still incubating. 21/8, two smallish chicks, perhaps 14 days old. 28/8, only one chick, with two rufous-throated birds standing beside the chick but not seen feeding it; no positive sign of the normal-throated parents. 2/9, chick lying passively in nest with one rufous adult standing beside it. 11/9, chick makes an abnormal call, "zee"; the two rufous birds still present and still showing no signs of feeding it during period of observation. 17/9, the young bird now looks much more robust and had the normal "kek" hunger call. 2/10 and 9/10, the young is standing on the topmost branches of the tree and should soon be fledged.

From these observations (incomplete, unfortunately) it would appear that around the end of August the normal pair deserted or died, and that the surviving chick was adopted and reared by the two rufous birds. It is possible but highly improbable that the normal pair might suddenly have become rufous, and in any case these rufous birds sat passively beside the chick and thus did not behave like normal parents, which arrive, feed the young and depart promptly. In fact, there is no positive evidence that the rufous birds

did feed it, though it is reasonable to assume so, as they were in undisputed loco parentis and the chick must have been fed to survive. Two comments may be added : (1) in the light of this record, a bird in charge of a chick need not necessarily be its parent, and (2) if the two pairs concerned had not differed in colouration, the change very likely would have been impossible to detect.

The newly-hatched downy chick has bare patches on the front of the throat and on the belly, and long pale down sprouting from the forehead. The iris of young birds at all stages is yellow, like that of the adult except in the red-eyed stage. A newly-fledged juvenile can be distinguished from an adult in a number of ways:

<u>Feature</u>	<u>Adult</u>	<u>Newly-fledged juvenile</u>
1. Crown.	1. Black, with long occipital plumes.	1. Dark grey. No plumes.
2. Chin.	2. White.	2. Pale rufous.
3. Strip down front of throat.	3. Speckled black and white.	3. Plain pale rufous.
4. Belly.	4. Dark grey.	4. Near white.

The best distinguishing feature for a juvenile is the rufous, un-speckled throat.

A description of a one-year-old juvenile follows. The age of this bird was precisely known, since it was rescued as a fledged chick from beneath the trees by Mr. Des Bartlett and reared by him. The crown was still dark grey, not yet black, but the chin had become nearly white, with only a little rufous remaining; the front of the throat, though still with a rufous tinge, had begun to show black dots and the belly was beginning to look grey, rather than white. If this is a normal one-year plumage it throws considerable light on the age at which birds may first breed, because in four years a bird in this plumage was only once seen at the heronry; all other flying birds seen here (bar a few melanistics of doubtful age) were either full adults or newly-fledged juveniles (the latter, no doubt, still being fed at the nest). It looks very probable, therefore, that birds only breed when they attain adult plumage, perhaps at the age of two years or so. (Lowe : 82 quotes evidence that the male A. cinerea breeds at 2 - 3 years, though one-year-old females have been seen feeding young.)

The adult feeds the young by regurgitation of food from the stomach, though a bird was once observed carrying food - an elongated rat-like object - in its bill, which it fed to a nestling. As soon as the chicks think that they are going to be fed - from the sight of the approaching parent, which it is thought they can recognise some way off - they start the hunger call, "kek-kek-kek-kek-kek, kek-kek-kek-kek-kek", a series of short, sharp reedy notes all at the same pitch, repeated again and again in groups as shown in the present example, with say 3 - 6 calls to a group. The notes are high-pitched and thin with small chicks, then deepen in pitch as the bird gets older. The young continue the hunger call during the whole of the time while the parent is at or near the nest, and only cease calling when it leaves. The hunger calls plus the arrival barks of the adult are the most characteristic sounds of the heronry. Lowe : 86 points out that young A. cinerea make these hunger calls till they leave the nest, and then never again.

The parent arrives at the nest making a short version of the arrival call (as for nest-building), and alights beside or upon the nest with crest raised; then, before regurgitating, raises the neck in a manner resembling the stretch display, except that the bill is horizontal (Pl. 4, Fig. 16). At times the wings may be raised and the cheeks puffed out as in Pl. 2, Fig. 8, but less intensively. As the parent arrives, the young on the nest increase the loudness of the hunger calls, lower their bodies by bending the legs, raise their crests, open the wings and often flutter them with a slow rotary motion (Pl. 4, Fig. 15) - all of which are presumably "releasers" to stimulate regurgitation on the part of the parent. With this species it seems clear that parents do not feed young anywhere but on the nest, and Lowe : 95 implies the same for A. cinerea. However, in Tanganyika recently one of the small herons, the Squacco Ardeola ralloides (Scopoli) was observed constantly feeding the young away from the nest, so the practice of feeding the young only on the nest clearly does not apply to all members of the family.

During regurgitation, the young bird seizes the bill of the parent near its base, and the latter passes the food direct into the mouth of the young in such a way that it is rarely possible to see what is passed. Regurgitation of food on to the floor of the nest has never yet been observed. On the few occasions when the food was seen it was the result of an accident, e.g. on one occasion a young bird was unable to swallow its regurgitated rat completely, and a brother caught hold of the protruding end, which resulted in a prolonged tug-of-war. Parents do not seem to find it easy to regurgitate, for which they need a short interval of peace and quiet, with neck stretched, and this, with the larger young anyway, is precisely what they do not get, as the young are constantly making leaps upwards to try to catch the parent's bill (Pl. 4, Fig. 16) and generally behaving in a rowdy manner; indeed, the later stages of parenthood in this species are in no way to be envied. When the chick catches the bill of the parent it pulls this down to near the floor of the nest, where regurgitation takes place, often with violent wing-flaps on the part of both birds. There is no evidence of young from one nest joining another and there being fed; in one case, when a parent was feeding its small chicks a large young bird flew over from another nest and begged for food, but was promptly ejected by the parent.

With this species it seems unusual for a parent with young to bring sticks to the nest or for young to play with sticks or add them to the nest, though both have been observed; judging by Lowe : 92 the practice is much commoner with A. cinerea. Twice chicks - not much more than half grown - were seen to do stretch displays; one of these was silent and the other a squeaky groan instead of the normal adult's coo. As will be mentioned shortly, a large flying young arriving at the nest will make an alighting call like an adult's, and this once caused a small brother to adopt the begging attitude, momentarily. The young do a number of exercises including stretching one wing outwards and downwards, the leg on the same side always being raised and stretched simultaneously (Pl. 3, Fig. 11). Lowe : 90 mentions the same for A. cinerea. Another interesting exercise is when the bird, on nest or branch, half-raises its wings, stretches the neck diagonally downwards with raised feathers and often pushes the bill into a patch of leaves (Pl. 3, Fig. 9). The only comparable observation which I can discover is from Meyerriecks

:11 for B.virescens, which he saw more often in nestlings than in adults, and where "the bird stretches its head and neck fully forward, then raises both wings over the body so that they meet".

Percy, 1951 : 33, mentions that with A. cinerea one or other parent keeps a constant guard upon the young until they are about three weeks old. This does not seem to be a normal practice with A. melanocephala, though it is sometimes done - e.g. the pair at the "great nest" of tree 24 did so in April 1961. Once, when a certain nest was unoccupied, it was taken over by a flying young from a neighbouring nest, which then drove off an adult that perched near by: it is surprising how aggressive these large young often are. Lowe : 91 refers to the bottle-like silhouette of the young heron when standing upright and points out that the near-vertical stance which herons often adopt gives them an advantage over most other birds as it enables them to stand back-to-wind without having their feathers ruffled. A young bird was observed asleep at 6.30 a.m. on a cold morning. It stood on one leg with the other tucked in; the body feathers were much fluffed out, the head sunk between the shoulders with the bill pressing against the breast, and the long downy feathers on either side of the head were raised to protect the face. Perhaps this is a normal cold-weather roosting posture.

Earlier in this account it was mentioned that parent birds will feed their young only on the nest; therefore, when the young finally leave the nest, they must fend for themselves from then onwards. For perhaps the last fortnight of their 60-day fledging period they are able to fly but cannot feed themselves, so must return to the nest to be fed. This is a critical stage in the life of these birds, since they must learn to take off from the nesting trees 70 feet above ground level, and, after flying about, land safely at the nest, and woe betide the young bird which lands on the ground, because normally it will have insufficient strength to take off again, and will starve. (Twice a juvenile was seen actually taking off from the ground, and several times birds succeeded after first climbing an elevated object in the Yard, such as a pile of drums; but such cases are exceptional).

A chick, as soon as it is sufficiently fledged, will prepare for flight by flapping exercises (Pl. 3, Fig. 12). These are done first on the nest, then on a branch, the flapping usually being stimulated by a gust of wind, with the bird facing into the wind, of course. The flapping is usually done in short bursts, and is vigorous and rapid. In the early stages the bird does not wish to be airborne, so, to prevent this, it will grasp the floor of the nest, or a branch, with both feet. Next, it lets go with one foot, waving it in the air with a pedalling motion, but holds on with the other. Finally it releases the grasp of the remaining foot and flies. It has not yet been possible to study an individual bird closely enough to ascertain what was a genuine first flight, and in any case "flight" would need to be defined; this should surely be more than a mere hop of a few inches. Genuine early flights of at least a hundred yards have often been observed, however, and follow this pattern : the bird takes off, usually in a gust of wind, and at once flies vigorously and with fair skill, the only obvious amateur features being the fact that it tends to keep the neck extended, instead of retracting it, and peers around; also, the feet are often left to dangle.

After flying about a little, it lands on one of the topmost branches of a neighbouring group of gums, with much difficulty, flapping wildly to keep its balance and bending forwards and backwards before becoming securely perched. After this, other landings, including back at the nesting tree, become progressively more skilful and graceful. When about to land at the nest the young bird often makes an alighting bark just like an adult's; indeed, a half-grown chick once uttered a squeaky alighting call on returning to the nest from a pedestrian excursion to a neighbouring branch.

Often these early flights to the clump south of area "B" are undertaken in the evenings, when the Pied Crows C. albus are coming in to roost, and the latter will dive at the perched heron, cawing vigorously, though these dives are not pressed home and look like play. By such tactics the young heron is by no means intimidated; it adopts the stiff-necked aggressive pose, with neck vertical, wings waving and open bill, making the threat-call "keh", and the crows do not persist. By this time, the flying young appears to possess most of the vocabulary of the adult bird, except the stretch-coo; nevertheless, when the parent appears with food, these flying young will rush back to the nest and squat down, begging and making the hunger call, just as if they were babies again. This account closely corresponds with that given for young A. cinerea by Lowe : 92 - 5, except that these do not appear to attain the adult vocabulary quite so soon.

This period of flying but needing to be fed has been included as part of the 60-day fledging period, and may, as already mentioned, last about a fortnight, Lowe's estimate for A. cinerea being 2 - 3 weeks. It is deemed correct to regard a young heron as unfledged till it finally leaves the colony. Once it does so, there is no evidence that the parents ever feed it again. Lowe : 95 believes the same for A. cinerea.

X. Photography and Sound-Recording

Most of the photographs which illustrate this article were taken from the balcony of the tower in 1960, shortly after its erection, while many nests were in easy photographic range. In all, I have some 350 black-and-white pictures of the heronry taken on either Ilford H.P.3 or Kodak Plus X film, and 230 colour pictures taken on Kodak High Speed Ektachrome film. The 16 photographs here reproduced provide, it is thought, a fair cover of the breeding activities of these herons. In 1960 I used a Minolta S.R.2 camera with its 250 mm. lens, and from 1961 a Leica M.3 camera with the Visoflex housing and 300, 400 and 600 mm. Kilfitt lenses. Most of the pictures illustrating this article were down with the Minolta, usually at a fast exposure of 1/1,000 second, with a fairly large stop, such as f.5.6. All were hand-held, without a tripod, this being a positive disadvantage with many action subjects, where it is essential to hold the camera free to aim instantly in any direction. The photography of birds in action has been revolutionized by the use of the miniature camera with a direct-vision penta-prism viewfinder and light lenses of about 300 mm. focus which can be held by hand. To view the subject, one looks directly through the lens, reflex-fashion - and a 300 mm. lens has the magnification of a x6

monocular. Moving objects can be focussed with great rapidity, and one can see what part of the picture will be in or out of focus and judge what the effect will be. Pl. 4, Fig. 14 - of the stretch display - was taken from a distance of 100 ft. with a 600 mm. lens on a tripod. This big lens, equal to a x12 monocular, can be invaluable for long-distance subjects, but is too heavy for use by hand and needs support.

Tape records of the vocabulary of this species were made with machines on loan from Cornell University, U.S.A. The noises made by these birds are raucous and difficult to convey in print, so it was advantageous to be able to record the actual sounds.

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Summary

1. The results of a four-year investigation - from 1958 to 1962- of a nesting colony of the Black-headed Heron, Ardea melanocephala Vigors and Children, are described and illustrated. The investigation continues.
2. The colony is located in Eucalyptus trees in the Stores Yard of the East African Railways at Nairobi, Kenya. The Railway authorities have co-operated in many ways, in particular by protecting the birds and by erecting an 80-foot observation tower.
3. A count of occupied nests was made each month over the 4-year period and each count was positive, i.e. breeding has been all-the-year or continuous over these four years. Such continuity occurs because individual pairs breed at different seasons and their respective breeding periods, taken in aggregate, result in a continuous overlap. Thus, the colony's breeding season is spread over the whole year. Similarly continuous breeding occurs with certain seabirds of Ascension Island and there is one comparable record for a land bird - a dove - in Scotland.
4. The Nairobi heronry was first occupied in 1954 and breeding may well have been continuous ever since, though proof prior to 1958 is lacking. Similarly, there is cause to suspect that another A. melanocephala colony at Kampala, Uganda, may have been occupied almost continuously for over 20 years. Taking Africa generally, however, the indications are that the breeding of this species may be seasonal rather than continuous.
5. Although breeding in the Nairobi heronry was continuous, there were pronounced peaks in occupation associated with rains and lulls associated with drought.
6. When rains were exceptional, a large increase in occupation followed, as could have been expected; however, the subsequent persistence in high-level occupation was unexpected : in 1958 this lasted for 8 months and in 1961-2 it has lasted for 12 months up to the time of writing, and still continues. Since A. melanocephala's breeding period is estimated at just over 3 months, such continuance implies that existing residents are having successive broods or that new birds are joining the colony, or both.
7. Poor rains resulted in small occupations which then dwindled. Periods of minimum activity were during the dry weather of August-September following poor rains in April-May.
8. Some evidence was obtained concerning food, hunting methods, roosts and the foraging area for breeding birds (up to 15 miles from Nairobi).
9. The colony periodically suffered from the depredations of the African Hawk-Eagle Hieraaetus spilogaster, which preyed on the young.
10. The iris is normally yellow, but changes to ruby-red with

breeding birds up to the time of egg-laying, when it again reverts to yellow. This is unusual.

11. Parents feed their young only on the nest. The latter, perhaps for their last fortnight at the nest, learn to fly but must return to the nest to be fed. The early efforts in flight of a young bird are thus critical, since if it lands on the ground it may well have insufficient strength to take off again, and will starve. After a young bird finally leaves the nest it is believed to feed itself from then on.

12. Efforts were made to obtain comprehensive photographs, 16 of which illustrate this paper. Calls were tape-recorded.

13. Much reference is made to available literature both of this species and of its near relations A. cinerea of Europe and A. herodias of North America. In this respect the works of Lowe, 1954 and Meyerriecks, 1960 were of outstanding value.

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(Received 21st. July 1962)

NATURE NOTE

A Tree New to Kenya

Mr. W.R. Birch of the Agricultural Department spent his long leave at the coast and, during the course of some weeks spent surveying the vegetation of that area, collected some most interesting plants. I looked through the collection when Mr. Birch came to the herbarium to name it and was quite surprised to find a specimen of Aporrhiza, a genus in the Sapindaceae. This genus has never been recorded for Kenya and curiously enough, although quite widely spread in Tanganyika, was omitted from the Check List of Trees and Shrubs of that territory compiled in 1949 by Mr. Brenan, presumably because no material had been seen, although several sheets had been collected long before that date including one by Mr. Brenan himself. The specific name of the tree needs some clarification. A. paniculata Radlk., described from the Sudan, seems to be indistinguishable from A. nitida Gilg ex Milne-Redhead described from Nyasaland and Northern Rhodesia, the earliest name being A. paniculata Radlk. In the key to the Sapindaceae given on page 501 in Dale & Greenway, 'Kenya Trees and Shrubs', it keys down to couplet 8 and resembles Majidea slightly, but has compressed, transversely ellipsoid fruits with 1-2 carpels fertile, up to 2.3 cm. long, instead of a 3-locular capsule. I take this opportunity to cite all the material available in the East African Herbarium.

Aporrhiza paniculata Radlk. in Sitzb. bayer. Akad. 8, 338 (1878), 9, 478, 469, 509, 20, 262, 291 (1890); Radlk. in Engl. Pflanzenreich, IV, 165, Sapindaceae 2, 1135 (1933).

A. nitida Gilg ex Engl., Pflanzenwelt Afr. 3(2), 280 (1921) nomen subnudum; Milne-Redhead in Kew Bull. 272 (1931) (full description).

SUDAN. Jei River near Lomindi, April 1930, Snowden 1669 (EA,K).

KENYA. Kwale District: Kwale-Tanga road near pipe line, 8 km. E. of Kinango, at lower forest edge, May 1962, Birch 62/66 (EA); shrubby (? coppice).

TANGANYIKA. Lushoto District: Makuyuni, 1935, Koritschoner 1329 (EA). Veruni Valley, W. Usambaras, 1934, Koritschoner 272 (EA): a big tree on river banks, seeds used as a poison, 'mzindanguwe' (Kishambaa). Morogoro District: Between Turiani Falls and Mahonda sawmill, in dense undergrowth with Memecylon amaniensis, Ouratea, Rinorea and Mesogyne in evergreen fringing forest of Chrysophyllum, Khaya, Cola etc., 4 Nov. 1947, Brenan & Greenway 8286 (EA, FHO): tree about 12 m. tall with dense bushy crown; young shoots green, becoming deep brown, leaflets stiffly papery, deep green and glossy above, pale green with prominent venation beneath, inflorescence axes and sepals pale grey-green, glands pale green, staminal filaments white, anthers cream, ovary pale grey-green. Turiani, Manyangu Forest, Sept. 1954, Semsei 1856 (EA,K): flowers yellow, timber very hard, used for making native beds and building poles, and same locality, Nov. 1953, Paulo 181 (EA,K): tall tree. Liwali River, Turiani by riverside, Nov. 1953, Semsei 1405 (EA,K). Morogoro, 450 m. 1 Nov. 1935, Rounce 490 (EA,K). Kiserawe

District: Vikindu Forest Reserve, Aug. 1953, Semsei 1303 (EA,K): tall slender tree valued by natives for hut poles, fairly common, and same locality and date, Semsei 1329 (EA,K) and same locality and date Paulo 123 (EA,K). Ulanga District: Mahenge escarpment, in riverside thicket, 750 m. Oct. 1951, Eggeling 6320 (EA,K): subscandent (sic) small tree 7.5 m. tall, flowers white.

Radlkofer in his monograph of the world's Sapindaceae (Das Pflanzenreich, IV. 165, Sapindaceae 2, 1135 (1933)) gives very poor distinguishing characters to separate A. nitida from A. paniculata - the relevant parts of his conspectus specierum reading as follows -

- A. Foliola oblongo-lanceolata, perbreviter obtuse acuminata a Folia 4-juga; paniculae cano-pulverulento-puberulae (sp. Afr. centr.) 1. A. paniculata
- C. Folia 2-4-juga, foliola ovali-lanceolata, breviter obtuse acuminata; paniculae fulvo-tomentosae (sp. nyassana)..... 4. A. nitida

Milne-Redhead says "ab A. paniculata Radlk., foliolis magis coriaceis et indumento ferrugineo recedit". None of these distinctions seem to hold true, although it is not usual for Sudan species to reappear in the Kenya and Tanganyika coastal forests although A. paniculata also occurs in Nyasaland, Congo and Northern Rhodesia. It is clearly one of those species which worked its way into the East African Coastal forests in a loop; I am convinced that many of the species in these forests arrived in that way since they could not cut across the ancient dry Somali wedge which extends down through Kenya into Tanganyika.

B. Verdcourt.

(Received for publication 17th. September 1962)

GREY KESTRELS IN TANGANYIKA

By

ELIZABETH LOOSMORE

I first saw the Grey Kestrels, Falco ardosiaceus Bonnaterre & Vieillot, on the day that we moved into the house of the District Commissioner, Shinyanga. The garden is a well-established one, the house was built in 1927, and there are plenty of big trees, which, in an area with comparatively few trees, such as this part of Sukumaland is, are an attraction to birds of many kinds. That was October 3rd., and I did not notice the birds again until the 7th. when I saw the pair of them flying across the garden making a lot of noise. Their call I should describe as a 'rattling whistle' (something like a squeaky bicycle) and it is distinctive and unmistakeable.

I started my day to day observations on October 13th., when I had seen that they were nesting in a Hammerkop, Scopus umbretta (Gmelin), nest. This nest, high up in the fork of a tree, is a typical Hammerkop construction. It is very big and made of grass and twigs, with all sorts of things dangling from it:- bits of paper, old seedpods, pieces of material and so on. Whether or not the Kestrels drove the Hammerkops away I do not know, but the Hammerkops were certainly there at the end of August, when the previous District Commissioner took photographs of them at the nest. The Hammerkops returned on a number of occasions and each time they were driven away by the adult Kestrels. The last time I saw a Hammerkop was just after the young Kestrels had started to fly and, on this occasion, both the adult Kestrels attacked it with great ferocity and beat it down to the ground before it was able to get away.

I noticed that on the whole the Kestrels were quite fierce birds. Once I saw them chasing a Grey Hornbill, Tockus nasutus (Linn.), which had a lizard in its beak. They flew round and round the garden, the Hornbill trying to get away and using all sorts of dodges. Unfortunately I did not see if the Kestrel got the lizard. Another time one adult Kestrel chased a pair of Pied Crows, Corvus albus Muller, which were nowhere near the nest, and pulled feathers out of them. On the other hand, they took no notice of a Great Spotted Cuckoo, Clamator glandarius (Linn.), perched quite near the nest, which made a lot of noise; and they themselves were scared off by three Lilac Breasted Rollers, Coracias caudata Linn., which were also making a great deal of noise as they flew round indulging in their spectacular aerobatics. The Kestrels chased the bats which come out from under our roof in swarms in the evenings.

The adult Kestrels were very shy of me and though I tried to hide (this was before the beginning of the rains and the trees were bare) they always seemed aware of my presence and would not enter the nest if they could see me. Many times they returned with food for the young (sometimes carrying it in their beaks, sometimes in their claws) and they would perch and call, fly round again, perch and call, tear at whatever food they were carrying, fly round again and so on.

Occasionally they would swoop up to the entrance hole of the nest and then swerve away again.

I first heard sounds from the nest (I should describe them as mewling) on October 14th., but it was not until the 21st. that I actually saw one of the adult Kestrels entering the nest carrying a lizard, and heard the same sounds which seemed to make it certain that there were young in the nest. The food that the adult Kestrels brought back that I saw was mainly mice, lizards, frogs, worms and large grasshoppers. By October 26th. both adult birds were hunting at the same time. They made a lot of noise often flying round and calling, or perching and calling for as long as 30 minutes at a time.

On October 27th. I saw two young birds near the entrance hole of the nest. It was difficult to see them very clearly because the nest is about 20 ft. from the ground and dark inside, but, with binoculars, I could see that their plumage was beige-fawn and their beaks were horn-coloured. The circle round the eye was white and the base of the beak (the cere) unlike the adult birds which are yellow in those places (a very helpful identification mark.)

From then on I saw the young Kestrels practically every day and noticed that they were more likely to be near the entrance hole when the adult birds were calling.

By November 5th. the young birds were very active in the nest and they seemed much bigger and greyer. They were scratching a lot and the down floated out of the nest; they were also much noisier.

On November 11th. two young (at this time I was not sure whether there were two or three young birds) were standing on the lip of the entrance hole and 'bobbing' from time to time. The young birds were quite uninterested in me and would stand and look down at me as I looked up at them, but the adult birds were still shy and would not enter the nest if they could see me.

On November 13th, the young Kestrels were making more noise and their call was developing into the 'rattling whistle' of the adult. They would stand and bob for long periods and I felt that it would not be long before they began to fly.

At this time the adult Kestrels changed their call. I thought at first that there was a 'new' bird in the garden and then I saw that it was the adult Kestrels. Instead of the 'rattling whistle' they were using a 'chattering alarm' note, as they flew round and when they were perched. Whether or not this was because the young were ready to fly and the parents were trying to encourage them I do not know, but, the next day November 14th. one young bird was out of the nest and perched on a nearby branch of the same tree. It was quite grey except for the barring on the underside of the tail and black streaks on the chest.

By now the rains had started and the nest was beginning to look rather the worse for wear with bits dropping off it and things dangling in front of the entrance hole. November 15th was very wet but when I heard a lot of noise from the nest I went out to see what was happening and saw one young Kestrel clinging to the side of the nest. It remained there for a few minutes clawing at the twigs and

flapping its wings, and then it flew to a tree about 20 yards away where it stayed for a short time, but the wind was rather strong and it did not seem very secure. It then flew to another tree nearer the nest and stayed there for at least half an hour. At one stage the adult Kestrel came back with a lizard for it which the young bird held in its claws to eat. The claws and legs of the young bird were yellow like the adults.

In the nest at the same time I could see one other young Kestrel standing on the lip of the entrance hole to the nest and bobbing, and, behind it I could see another bird but it was impossible to see if it was a young bird or an adult.

At lunchtime on November 16th, in extremely heavy rain, one young Kestrel was perched in a tree near the nest, and looking very bedraggled. However, it cleared later, and I spent the whole afternoon and early evening watching. There were now three young Kestrels in trees near to the nest. They spent their time flapping about and scrambling up the branches. From time to time the adults returned 'chattering' and carrying food. Once they brought a large grasshopper and another time a very large lizard. The young Kestrel which was on rather an awkward branch, had quite a time coping with so big a meal. It began with wings spread slightly to help it to maintain its balance while it tore at the lizard with its beak, then it got a better hold with one claw and held the lizard in the other claw. It eventually dropped the lizard to the ground having eaten more than half of it. At one time the three young Kestrels were all in the same tree with one adult, the young all 'rattling' and the adult 'chattering'. This was the day that the Hammerkop was so savagely attacked.

On November 17th, the young birds were all out early in the morning in branches of trees near the nest. Two seemed more sure of themselves than the bird which was still scrambling, and as it fluttered and clambered about it seemed that it might overbalance.

In the afternoon there were four Kestrels sitting on one branch of a tree just outside the garden. One must have been an adult but for once it let me come quite close before flying away and I must admit that I thought at first it was a fourth young bird but I do not think it could have been. However, the three remaining young ones sat and preened themselves and ate the food that the adults had brought them earlier. They were there for over an hour and did not move even when I climbed up into the tree to take a photograph of them from about 8 ft. away. I noticed that, as in the nest, they bobbed from time to time and also, that they sometimes sat holding on with one claw and with the other tucked up.

I was away all day on November 18th and neither saw nor heard the Kestrels and on the 19th, which was again, an exceptionally wet day I did not see or hear them; but, on the 20th in the afternoon, I heard them calling from a Baobab tree about 200 yards from the garden on the other side of the railway line. I went over and saw two young Kestrels in the tree and the third one on a telegraph pole not far away, where it was fed by one of the adult Kestrels.

The Kestrels remained in the Baobab and did not return to the nest or the garden. Until November 23rd. the three young remained

Grey Kestrels in Tanganyika

in the Baobab and were fed by the adult birds which were still 'chattering' but, on November 28th, only one young Kestrel was seen and one adult, and I noticed that the adult had changed back to its original 'rattling whistle' once more. The young bird was still white around the eye and at the base of its beak.

I have not seen the Hammerkop since November 16th.

(Received 12th. December 1961)

BIRD NOTES

A First Record of the Imperial Eagle, Aquila heliaca, Savigny,
in Kenya.

The eagle was first sighted soaring at no great height but some distance away, at which stage, from the general darkish appearance and heavy build and flight, I took it for a Brown Harrier Eagle. The bird, however, settled on a tree about 100 yards from the road, enabling me to examine it with binoculars from various angles. Distinguished then from Brown Harrier Eagle by feathered tarsus, and white markings in scapulars; from Greater Spotted Eagle by absence of white at base of tail. The bird would not allow me to approach nearer than about seventy yards when it took wing; the flight feathers were not pale below. The lighter colouring of the head and neck was not noticeable in this specimen, except when it was in sunlight, but were then plain.

It so happened that the position in which the bird first perched was with its breast away from the road along which I was passing, the white on the scapulars being the feature which I first noticed and which made me stop to examine it more closely. But for this, I would probably have dismissed it as a Brown Harrier Eagle, these being seen about the area from time to time. As it was, I examined it carefully under excellent conditions and am left in no doubt as to what it was.

G.H.H. Brown. 28/8/62

Note: The above observation has been checked with the observer, and is considered to have been correct. However, there is always a slight doubt attached to sight records of such rare birds. There is no reason why an Imperial Eagle should not visit Kenya, though the main wintering area of the species seems to be further north and east.

L.H. Brown.

The Marabou Stork, Leptoptilos crumeniferus (Lesson), killing
Live Prey.

During the dry seasons at Wajir, thousands of sandgrouse and many hundreds of the Half-collared Doves, Streptopelia decipiens (Finsch and Hartlaub), and Streptopelia capicola (Sundevall), used to come daily to a bird trough outside the D.C.'s house. Marabou Storks would often sneak up on them and snap up an unwary dove from behind. The dove just vanished into the beak leaving a few drifting feathers. The storks also used to try and snap at sandgrouse sometimes, but I never saw one succeed in catching one of these, though they came very near it sometimes.

Neither doves nor sandgrouse were willing to come down to the trough if a stork was nearby; they would pitch some way away but move to the water at once if I went out and put the Marabou off. It was noticeable that although they were chary of the Marabous, they never paid any attention to the three Tawny Eagles which habitually

sat on the roof of the house or on the tree beside it. The eagles never paid any attention to the doves and grouse either; having always collected a cropful from the slaughterhouse at first light.

G.H.H. Brown. 10/10/62

Note: The Marabou Stork has, on a number of occasions, been seen to strike and kill adult Lesser Flamingos, Phoeniconaias minor (Geoffroy). The method of attack in the instances observed was to fly up behind a flock, land and strike one of the individuals in the middle of the pack. The flock of flamingos is invariably panicked by Marabou Storks in flight and, if tight packed, the individuals cannot take off easily, and very easily fall victims to storks.

L.H. Brown.

Recent Records of the Lammergeyer, Gypaetus barbatus (Linn), in Western Kenya.

On 25.1.55 at about 11,000 ft. on Mt. Elgon above Kimilili, a Lammergeyer was seen. It was cruising about near some cattle kraals belonging to Elgonyi tribesmen. On 1.11.59 another was seen near the Kwoitobos summit at about 12,000 ft. 2 - 3 miles from the Suam gorge. This bird appeared at about 10 a.m. sailing over from north to south, and had probably roosted in the gorge. Closer examination of the gorge, however, did not reveal any signs of breeding.

A pair of adults was seen on Murua Ngithigerr (Muruanisagar) Mountain in Turkana. This is not actually west of the Rift Valley, being an isolated mass of about 7,000 ft., some forty miles west of Lodwar and 30 miles east of the Karamojong Escarpment.

Note: These records appear to be a considerable westward extension of the known range of the Lammergeyer in East Africa. J.G. Williams also reports the species from the Cherangani Hills.

L.H. and G.H.H. Brown.

Habits of the Lammergeyer.

During an ascent of Kilimanjaro, an immature Lammergeyer appeared and accompanied the safari on the march from the Bismarck to the Peters Hut. It first appeared almost as soon as the safari emerged from the giant heath and began to contour along over the open grasslands. It drifted away at times, and returned again to hang about. Shortly after leaving the spot where the party halted for lunch, the Lammergeyer was noticed to drop onto the place where we had been.

Its behaviour was exactly that of a seagull with picnickers at Margate. This bird had clearly come to associate parties moving over this track with supplies of edible scraps. There is, of course, no reason why any scavenging bird should not adopt the practice; but one does not associate it with Lammergeyers in East Africa.

One of a pair seen on Muruanisagar, Turkana, was observed at one time carrying a varanus lizard in its feet. The lizard was held

fore and aft after the manner in which Harrier Eagles carry snakes. Comparing the apparent size of the lizard against the span and body length of the Lammergeyer, I conclude that it was not less than two feet long and not as much as three feet long.

The Lammergeyer on this occasion was travelling fast and straight, as though it were making a definite point for some spot. The flight was, as always, slightly swooping and tilting in a rapid glide; which would have caused a certain amount of swaying in the suspended prey; but the movements of the lizard's body did not appear to conform to this, either as to frequency and angle. I think that the lizard was still alive and writhing; and that the Lammergeyer may have been making a straight run to a favoured ossuary.

This, if so, would indicate that while the Lammergeyer can pick up and carry prey in its feet, it has not the crushing and killing grip of eagles.

G.H.H. Brown

The African Cuckoo Falcon, Aviceda cuculoides Swainson,
in the Mpanga Forest.

A definite record of this species was made in the Mpanga Forest, 10 miles from Fort Portal on the Kampala road. Once the call had been recognised it was unmistakable and from it the birds were easily found.

The call was a double noted whistle starting on a high note and falling to a lower note, the endurance of the high note being less than that of the low note. At times the whistle was almost plaintive.

There appeared to be about four individuals which were sighted on five different days. They had the habit of circling high in the sky and calling continually. One bird would usually circle in the sky calling, and would soon be joined by another. The sizes of the two birds were usually different, possibly indicating different sexes.

On one occasion a bird settled in a tree and called continuously for half an hour, showing no fear of my watching and imitating it. When the bird eventually took flight, the pure chestnut underwing coverts were clearly visible. There was no question of white barring on the chestnut when observed through 10 x 50 power binoculars.

I have had considerable experience with Cuckoo Falcons in Kenya, having collected several specimens at Limuru.

R.W. Sutherst, 10/10/62

Note: The above behaviour is suggestive of nuptial display in this species and is similar to nuptial displays described in other species of Aviceda, Ed.

Notes on the African Hobby, Falco cuvieri Smith.

On the 6th. May (c. 1958) the nest of this species was located in the old nest of another bird, probably an Augur Buzzard, about 60 ft. up in a large cedar tree near Maralal. A pair were present and could be recognised by the following features.

Male Above - plain dark slaty grey with a very noticeable U-shaped chestnut patch on the nape.
Below - plain rich creamy chestnut. Around face white except for occipital stripe.
Feet and cere orange, tail and wings the same length when perched.

Female Above - as male. U-shaped patch less pronounced.
Below - much paler than male with streaks on chest and flanks.
Feet and cere pale yellow-orange, tail slightly longer than wings when perched.

On a later occasion an opportunity occurred to compare the birds with a pair of European Hobbies, Falco subbuteo Linn., which visited the area. The European Hobbies could be immediately distinguished by their paler and streakier undersides and larger size. Falco cuvieri shows chestnut under the wings, whereas F. subbuteo has a mottled appearance under the wings.

The calls of Falco cuvieri were first a high-pitched 'chic-chic' by the pair near the nest, and secondly a shrieking call by the male, answered by the female with a similar call.

On the 6th. May the nest contained two downy young. They were dirty creamy yellow with blue grey feet and cere. While examining the nest, I was attacked by the birds and several times they passed within two feet of my head.

On subsequent occasions the male was never seen to visit the nest, and the female was never seen to hunt, except for flying termites. The male brought all the prey to the young, calling the female off to receive it and passed it to her either in mid air or in a tree. If in a tree, the female took the prey from him with fluttering wings and would perhaps eat a little herself and then fly with the rest to the nest. If the food pass occurred in the air, the female returned to the nest at once. Before landing on the perch, both birds always transferred the prey from the feet to the beak. The female when catching termites caught these in her feet and transferred them to her beak while still in flight. All birds brought were already plucked by the male, but the feet and legs were left intact.

On one occasion the female did not collect the prey from the male. He was then seen to wedge it in a crotch of a branch and fly away, catch a bird, pluck it and return.

Birds were the only food seen taken to the nest, and varied from the size of waxbills to the size of sparrows.

All birds, no matter what size, were driven away from the nest area. Starlings were driven away just as vigorously as Tawny Eagles or Bateleurs, and the falcons were very aggressive throughout.

A few weeks after my first visit on the 6th. May, there were still two young, much larger and covered in grey down with the feet and cere still blue grey. Brown tail feathers were sprouting through the down. The young were later still seen scrambling around on the nest and flew safely. After they had flown, I visited the nests and found few castings. The structure was, however, alive with tiny lice.

(Adapted from the original notes by the late N.M. Forbes-Watson)

Use of a Live Perch by the Red-Winged Starling,
Onychognathus morio (Linn.)

On 25th. September 1960, near a rocky ridge west of the Ngong Hills, I saw two Red-winged Starlings, flying along and to my surprise, they settled on a pair of Klipspringers, Oreotragus oreotragus, Zimmermann, which I had not previously noticed. For about ten minutes the birds climbed over the backs and heads of the Klipspringer, presumably searching for insects. Nearly all the time the Klipspringers kept quite still while this was going on, even when the birds were very close to their eyes.

It seems interesting that the starlings should be closely related to the Oxeckers whose similar association with game and cattle is so well known. Incidentally a few days later I saw a domestic cow drinking at Lake Naivasha, and a Red-billed Oxecker, Buphagus erythrorhynchus (Stanley) which was on its back, took advantage of the fact to clamber down the side of its face and have a drink too.

H.J. Lee.

Note: Use of an animated perch by this species has not, to our knowledge, been recorded before, Ed.

The Extension of the Range of Hildebrandt's Starling,
Spreo hildebrandti (Cabanis)

In September 1958, individuals of this species were observed on the way from Thomson's Falls to Mr. Edwards ranch close to the entrance to Mr. Carr Hartley's property. They were in a mixed party with Superb Starlings, Spreo superbus (Ruppell) but quite unmistakable. They showed a different shade of orange under the chest, no white dividing line and were much slimmer birds altogether. The red iris, which is a diagnostic feature, was also seen. This record is a considerable westward extension of the species range.

E.J. Blencowe.

Note on the Pearl-Spotted Owlet, Glaucidium perlatum (Vieillot).

An owlet of this species was observed at Kithimani, harrying a Violet Wood-hoopoe, Phoeniculus damarensis (Grant). The Wood-hoopoe brought food to the nest tree for their young. The owlet then attacked them to seize the grubs brought. The owlet flew straight at the hoopoe from a perch about 15-20 ft. away, knocked it off balance and even off its perch, and went away with the prize. The owlet would make two or three attacks in half an hour, and it appeared necessary for it to catch the Wood-hoopoe off guard. Unless taken by surprise, the latter usually retained the prey. I thought at first that this behaviour was more reminiscent of a Little Owl, but the owlet sat about in good light and I checked in fact that it was Glaucidium perlatum.

G.H.H. Brown.

The Communal Roosting of the Black-Shouldered Kite,
Elanus caeruleus (Desfontaines).

In early October, 1958, accompanied by Miss E.J. Blencowe, I saw a number of Black-shouldered Kites preparing to roost in three stunted thorn trees in one of the paddocks on my farm. The trees were growing close to a large dam, and in one tree approximately 28 Kites rested; in a second between 30-40 and in the third a few birds only. The fourth tree further away was also occupied by a small number of Kites. It was clear that the trees must have been used as roosts for some considerable time, as the grass round about was white with droppings, and there were also a considerable number of pellets.

Just as it was beginning to get dark, a party of seven owls appeared and started to attack the Kites. They were not apparently successful and were too far off for certain identification, but were almost certainly Cape Grass-Owls, Tyto capensis (Smith).

A. Christopher.

Note: Communal roosting in Elanus caeruleus has rarely been recorded, although it is a well known habit in other species of the genus Elanus, Ed.

A Note on the Violet Wood-Hoopoe, Phoeniculus damarensis, (Grant)

As Praed & Grant, Handbook of E.A. Birds, Vol. I, p. 635 (1952), state that the nest and eggs of this species are undescribed and that there are no records of breeding, the following may be of interest:

A pair nested at Kithimani Boma, Machakos Yatta, 1960. The nest was not discovered until the young had hatched. In any case the site was in a live hollow tree hidden by the angle of the hole and not visible without destroying the nest. The young left the nest either in the last days of August or early September.

When first seen on the 4th. September 1960, it was able to make strong flights for 30 - 40 ft., but was content to be fed at the nest tree by both parents until the 20th. when it disappeared. The young bird was about half the size of the parents on emerging. It was similarly marked, but with a matt and not glossy plumage and the usual untidy look of a fledgling. Its bill was short, nearly straight and black at first. By the 18 - 20th. of the same month it had become much larger and developed a curve, but was still mainly black, showing a reddish tinge at the base. The tail feathers were fully developed in proportion to the body size by the 4th September.

The food brought by the parents was grubs, grasshoppers and what looked like snails without their shells. A large hairy caterpillar was brought once.

A pair of the species had nested in the same tree but not in the same hole in September, 1958. This suggests that these birds like to return to a good site. The 1958 nest-hole was plugged by termites in 1960.

A second pair bred somewhere in the bush at the same time in 1960 and were seen with a single young bird. These records would indicate that September - October is the regular breeding seasons. The pair that nested in the boma still returned with food to the nest tree, calling the young after it had disappeared, which would indicate that the latter may have been taken by some predator. The calls were sharp, single squawks. After a while the pair would perform mutual bowing displays and a type of rotated dance with half spread wings on a flat branch with much mutual cackling. It was at this stage that they were harried by a Pearl-spotted Owlet, Glaucidium perlatum. (Vieillot).

G.H.H. Brown.

(Received 28th. August 1962)

Whale-headed Stork, Balaeniceps rex Gould

On the 2nd. February 1962 I was able to observe for some time a single Whale-headed Stork on the edge of the North Rukwa plain in the Rukwa Valley. According to Praed and Grant 1952 this bird has not been recorded in East Africa south of Lake Victoria and the Kagera River. A recent article in the Northern Rhodesia Journal (1961) shows that it has been reported on Lake Mujungu near the Ruanda Urundi - Tanganyika border in 1955 - 56, at Nkilandagoga Village in the Kibonde District, and also by W.S. Isemonger in the Rukwa Valley in 1955 and 1957. It is, however, not mentioned by Vesey-FitzGerald and Beesley (1960).

When sighted this Whale-headed Stork was feeding in company with Saddle-billed Stork and Greater and Lesser Egrets in short grass flooded to a depth of a foot. This flooded grassland abounds with fish, mainly Polypterus, frogs and aquatic insects but it was not possible to identify what was caught. Praed and Grant state that the Whale-headed Stork hides by day and feeds in the evening but this does not agree with my observations.

Bird Notes

Various reports have been made of the noisy flight but on the one occasion during the period of observation that this bird made a short flight it was completely silent, and also flew with the head held back like the Heron and Pelicans.

The Whale-headed Stork is certainly an extremely uncommon bird in the Rukwa Valley due to the lack of permanent swamp with papyrus and breeding has never been recorded. During years of high rainfall, however, large areas are flooded and form a temporary favourable habitat for the occasional visitors.

References.

- PRAED, C.W. and GRANT, C.H.B. (1952), Birds of Eastern and North Eastern Africa, Vol. I p. 62.
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VESEY-FITZGERALD, D. and BEESLEY, J.S.S. (1960). An annotated list of the Birds of the Rukwa Valley, Tanganyika Notes and Records, No. 54, pp. 91 - 110.

G.J.W. Dean, Abercorn,
N. Rhodesia.

(Received 22nd. February 1962)

LETTER TO THE EDITOR

Dear Sir,

Dragonfly Migrations

I have read with interest in the June 1962 issue of your Journal the letter of your correspondent and your own comments on this subject.

It may be worthy of record that immediately after a severe cyclone which struck Mauritius on Christmas Day last year, vast numbers of the dragonfly Pantala flavescens could be observed all over the island. It can be surmised that the migration flight was caught at sea by the hurricane winds and diverted to Mauritius. I believe that a similar case was observed in the Cocos-Keeling Islands several years ago.

Yours, etc.,
J. VINSON,
Director, Mauritius Institute.

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